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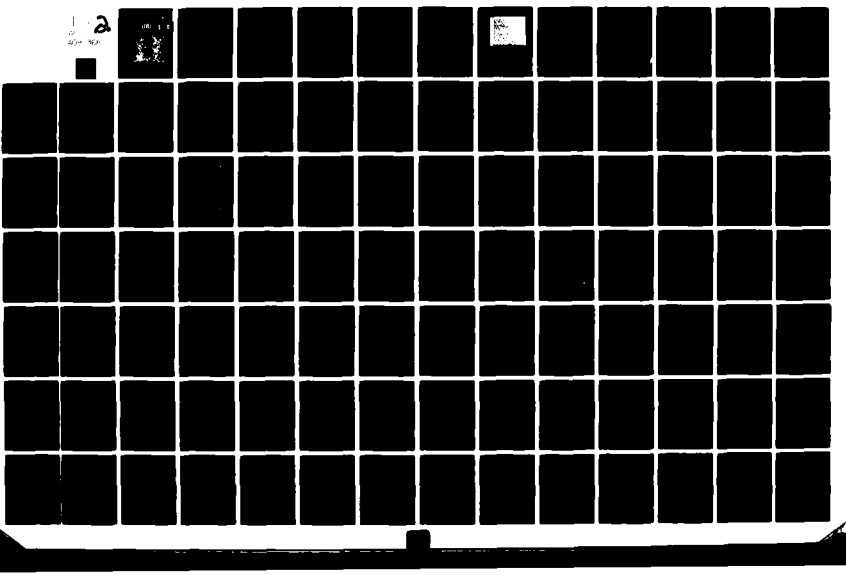

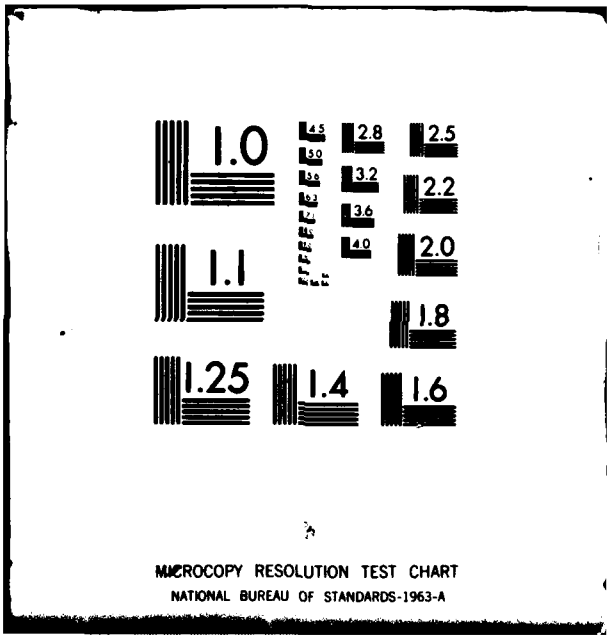
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JULY to SEPTEMBER 1979 VOL. 4, NO. 3

SCIENTIFIC BULLETIN

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DEPARTMENT OF THE NAVY OFFICE OF NAVAL RESEARCH TOKYO

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Electronics	Australian marine science	Neurosciences
ASEAN marine science	Indonesian marine science	Biophysics
Snellius expedition	Japanese marine science	Radiation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is a quarterly publication presenting articles covering recent developments in Far Eastern (particularly Japanese) scientific research. It is hoped that these reports (which do not constitute part of the scientific literature) will prove to be of value to scientists by providing items of interest well in advance of the usual scientific publications. The articles are written primarily by members of the staff of ONR Tokyo.

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19. Key Words (cont.)

Chinese physics
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Korean science
Protein research
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Mössbauer resonance
Japan Foundation
Australian mathematics
Australian statistics
Molecular science
Cerebral blood flow
Cerebral metabolism

20. Abstract (cont.)

with certain reports also being contributed by visiting stateside scientists. Occasionally a regional scientist will be invited to submit an article covering his own work, considered to be of special interest.

CONTRIBUTORS

Leon H. Fisher recently joined the staff of ONR Tokyo and is on leave from California State University, Hayward. H recently completed an eight year assignment as Dean of Sciences at Hayward where he is also Professor of Physics. He has held professorships at New York University and at the University of Illinois. He has led research groups at the Lockheed Palo Alto Research Laboratory and the General Telephone and Electronics Laboratory. He has been visiting professor at the University of California, Berkeley, the University of Washington, and the University of Southern California. His specialty is gaseous electronics, and his interests include ionization coefficients in gases, mechanism of electrical breakdown in gases, formation of negative ions, corona discharges, and plasma physics. He recently has coauthored articles on contact potentials.

Francis A. Richards, presently on the staff of ONR Tokyo, is on leave from his position of Professor of Oceanography and Associate Chairman for Research, Department of Oceanography, University of Washington, Seattle. His research interests in chemical oceanography include analysis of sea water, plankton pigments, oxygen-deficient and sulfide-bearing environments in the ocean, and interrelationships among the branches of oceanography through chemistry.

Ju-shey Ho was born in Taipei, Taiwan, and received his B.S. from the National Taiwan University. His graduate work was at Boston University where he received his M.S. and Ph.D. degrees in zoology. His is now on the faculty of the Department of Biology, California State University at Long Beach. His scientific interests are in the crustacean parasites of fish and copepod parasites of invertebrates. He is particularly interested in tracing the evolutionary background of certain fish by studying their parasitic copepods (sea lice).

Mitchel Weissbluth, currently on the staff of ONR Tokyo, is on leave from his position of Professor of Applied Physics, Stanford University. His research activities include the development of liquid propellant rockets, meson production, linear accelerators for medical use, biological effects of high-energy radiation, electron spin resonance in molecules, Mössbauer resonance in heme proteins, synchrotron radiation, and other related fields.

George N. Catravas is Chairman of the Biochemistry Department at the Armed Forces Radiobiology Research Institute, Defense Nuclear Agency, Bethesda, Maryland. He is also Adjunct Professor of Biology at the American University, Washington, D.C. His current research interests include effects of ionizing and non-ionizing (microwave) radiation on the central nervous system.

Joseph F. Weiss is Chief of the Physiological Chemistry Division of the Biochemistry Department at the Armed Forces Radiobiology Research Institute, Defense Nuclear Agency, Bethesda, Maryland. His research interests include biochemical indicators of disease and injury and immunological effects of radiation exposure.

Thomas Harrington is Associate Professor of Psychology at the University of Nevada, Reno. His special interests include visual perception of the "blur patterns" information associated with rapid observer motion and the neurophysiological correlates of visual and cutaneous motion perception. He has spent the past year touring perception laboratories in Europe and doing research on the psychophysics of cutaneous motion perception in Australia at the department of Physiology, Melbourne University Medical School. The last part of the year was spent at the Tokyo Metropolitan Institute for the Neurosciences performing single-cell electrophysiological recordings in the parietal cortex of behaving monkeys to analyze the roles of eye movement, stimulus movement and motivational factors on brain functioning and behavior.

Harley J. Walker is a Boyd Professor in the Department of Geography and Anthropology at Louisiana State University. He is currently a Japan Foundation guest professor at Tsukuba University. His interests lie in the areas of arctic hydrology, coastal morphology, and coastal defense systems.

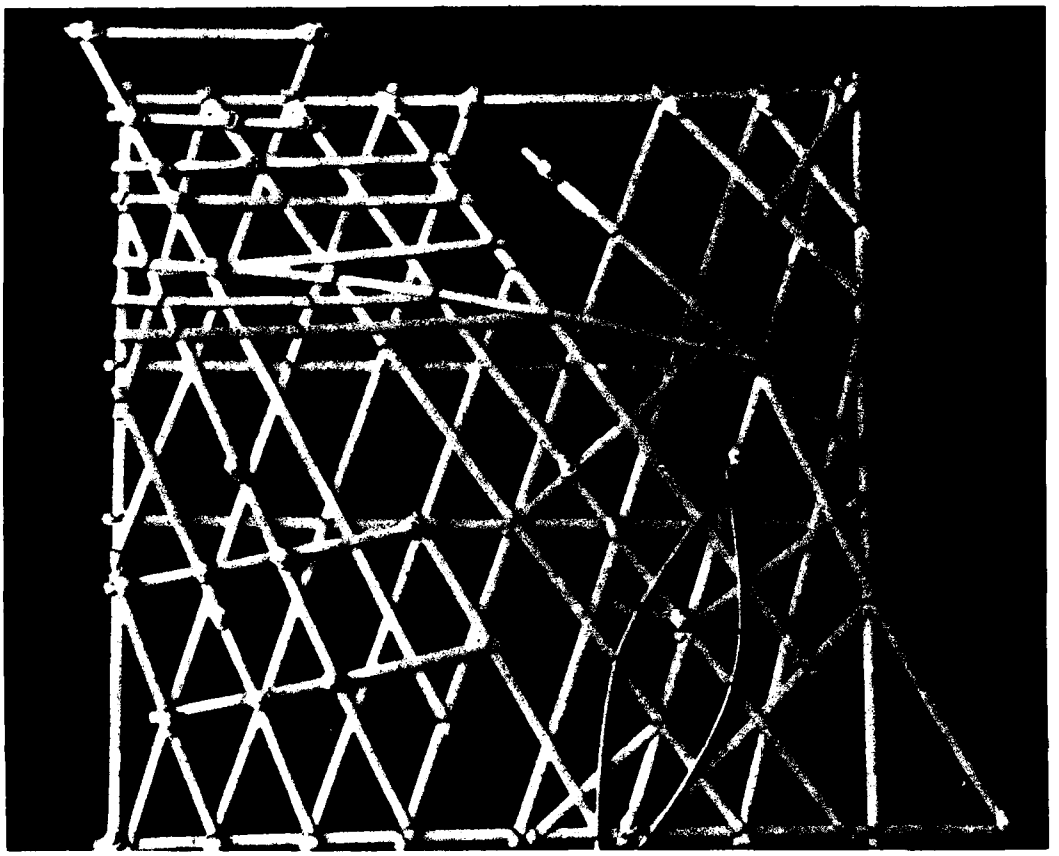
Rudolph J. Marcus served 14 years at ONR Pasadena before becoming Scientific Director of ONR Tokyo in March 1979. Special areas of concern during that time were photochemistry-photophysics and computer control of chemical experimentation. Dr. Marcus served as founding secretary of the American Chemical Society's Division of Computers in Chemistry (1974-79). His papers on photochemical energy conversion in the 1950's are still being cited.

Seikoh Sakiyama, Scientific Affairs Specialist of ONR Tokyo, has had considerable industrial experience in laboratory chemistry, electronic instrumentation, and quality control methodology. His interests include computer science, linguistics, and energy technology.

CONTENTS

Cover: Stone rubbing print depicting Thailand dancers. (courtesy of Dr. Francis A. Richards)

EDITOR'S NOTE



The spectacular navigation chart which graced the cover of our April-June 1979 issue, and which is reproduced here, is owned by E. O. Johnson, Director of Research, RCA Laboratories of Japan. Mr. Johnson kindly made this picture available to us. We thank him and regret omission of the credit and descriptive information.

The descriptive information is as follows: "A navigation chart - with sticks and shells, Marshall islanders map the sea. Bowed sticks mark ocean swells curving with reflections from the islands. Majuro is at top center marked by a cowrie shell. Kwajalein is left center. Little Ebon Island is at lower right. Other shells mark the many atolls of the Marshalls, all accessible to the far-ranging sailing canoes of the Marshall islanders."

ELECTRONIC AND ATOMIC COLLISIONS
XI INTERNATIONAL CONFERENCE

Leon H. Fisher

The eleventh International Conference on the Physics of Electronic and Atomic Collisions (XI ICPEAC) was held from 29 August-4 September, 1979, at the Kyoto International Conference Hall (KICH). KICH, which opened in 1966 and has 6.9 acres of floor space, was described briefly in an earlier ONR/Tokyo Scientific Bulletin (Vol. 3, No. 3, 1978) as "a most elaborate and elegant convention center designed in a bold and imaginative architectural style and situated on a lake with a backdrop of rolling hills."

The first ICPEAC was held at New York University (NYU) in 1958. At that time, ONR was supporting two programs in atomic collisions at New York University, an experimental one with B. Bederson and a theoretical one with S. Borowitz. Sidney Reed of ONR told Bederson and Borowitz that ONR was interested in sponsoring an international conference on collision physics. Since NYU had twice as many contracts in collision physics with ONR as did any other institution, he suggested that NYU organize the conference. I was then on the NYU faculty and was the chairman of the opening technical session. About a hundred physicists attended I ICPEAC. About a quarter of the attendees were from outside the U.S. V. Dukel'skii and N. Federenko of the U.S.S.R. attended. I ICPEAC was an important beginning for establishing contact with workers not only from the U.S.S.R., but from other countries as well.

From the very first ICPEAC, the subject matter has been limited to the consideration of two-body interactions between ions, atoms, molecules, electrons, and photons.

ICPEAC has grown and prospered since 1958. Subsequent meetings were held at Boulder (1961), London (1963), Quebec (1965), Leningrad (1967), Cambridge (U.S.) (1969), Amsterdam (1971), Belgrade (1973), Seattle (1975), and Paris (1977).

Thus, XI ICPEAC was the first held outside of North America and Europe. The Japanese have been wanting to have the meeting in their country for some time. They made this clear six years ago, and four years ago the meeting was set for Japan. It is obvious that Japan wants to take its place as a leader in collision physics. In fact, at least three American attendees of XI ICPEAC were invited to spend six weeks visiting and lecturing in Japan (A. V. Phelps, Joint Institute for Laboratory Astrophysics, H. S. Taylor, University of Southern California, and L. Wilets, University of Washington). The providing of support for these extended visits indicates the desire of the Japanese establishment and scientists to cement ties with foreign workers.

Because of the location of the conference, only about half the usual number of people attended. Eighteen scientists from Japan attended and presented 16 papers at IX ICPEAC in Seattle. Perhaps half a dozen scientists from Japan attended X ICPEAC in Paris. In contrast, almost 280 scientists from Japan were present at XI ICPEAC and presented some 70 papers.

The breakdown of participants at XI ICPEAC by countries is: Australia 6, Austria 3, Belgium 2, Brazil 1, Canada 8, China 5 (this is the first ICPEAC attended by delegates from the Peoples Republic of China), Denmark 5, France 33, West Germany 52, Hungary 1, India 6, Israel 4, Italy 5, Malaysia 1, Mexico 1, Norway 3, Sweden 1, Switzerland 1, The Netherlands 8, United Kingdom 14, U.S. 117, U.S.S.R. 16, Yugoslavia 2. (Total: 24 countries, 572 participants). Thus Japan represented 48 percent of the total attendance, whereas in meetings held in U.S. the comparable percentage was about 1.5.

The conference was sponsored by the International Union of Pure and Applied Physics and the Japan World Exposition Commemorative Fund. The local organizers of the conference were the Science Council of Japan (an official agency of the Japanese Government) and The Society for Atomic Collision Research (Japan).[1]

The officers of XI ICPEAC were chairman, J. Kistemaker, The Netherlands; vice chairman, R. F. Stebbings, U.S.; secretary, J. S. Risley, U.S.; treasurer, F. J. de Heer, The Netherlands. The chairman of the local committee was K. Takayanagi.

The organization of the meeting was unusual in many respects. The atmosphere was leisurely and unhurried. In part, this was due to the fact that the conference opened on a Wednesday and ended on the following Tuesday with no technical sessions being held on the weekend. All sessions were very well attended, including the very last one on Tuesday afternoon. This was the first ICPEAC at which all contributed papers were presented at poster sessions. (ICPEAC at Seattle in 1975 tested the poster session format; it was expanded at the Paris meeting.) This arrangement eliminates the necessity for a large number of parallel sessions usually encountered at large meetings. However, young researchers do not gain the experience of addressing a large and somewhat heterogeneous audience. Also, non-experts may hesitate to engage an author in a discussion whereas such non-experts might get a general idea of the work from a presentation. When poster sessions were not being held, there were either two simultaneous sessions or only one session (most of the time there was only one session). These sessions (other than the poster sessions) consisted of the opening ceremony, an "opening lecture," two "invited lectures" and a number of "review talks," "progress reports," and "symposia." ((A book of abstracts of contributed papers (1043 pages) was available before and during the conference. A book of "invited papers" will be available early in 1980. Both the book of abstracts and the book of invited papers may be ordered from the North-Holland Publishing Company, 52 Banderbilt Ave., New York, N.Y. 10017.))

The opening ceremony was preceded by a performance of koto, a 400-year-old traditional stringed instrument of Japan (developed from a Japanese zither). Short addresses were given by J. Kistemaker, chairman of the conference, K. Husimi, president of the Science Council of Japan, and K. Takayanagi, chairman of the Society for Atomic Collision Research (Japan) and local chairman of XI ICPEAC. Dr. Kistemaker spoke of the new tools now being used in this field such as computers, lasers, and particle accelerators. He mentioned that the energy range of interest of this conference now extends from less than one electron volt to 10^9 electron volts. He pointed out that several thousand workers are now kept busy in this field. He paid tribute to the pioneering work of Japan in collision physics, particularly to the early work of Dr. Husimi (age 80) and of his "student" Dr. Kodera (age 70, professor emeritus, Kyoto University and co-author of a contributed paper at XI ICPEAC). He spoke of the large number of Japanese workers, and of the 35 research institutes, concerned with atomic collisions, and mentioned the Society for Atomic Collision Research (Japan). He pointed out that the field of atomic collisions is one of the most basic subjects underlying the physics of gas discharges, gas lasers, plasma physics, and controlled thermonuclear reactions. He stated that nuclear phenomena are further removed from daily life than those of atomic collisions, and pointed out how he himself went from isotope studies to the physics of atoms and molecules.

Dr. Husimi discussed the nature of the Science Council of Japan.[2] The Science Council of Japan is composed mainly of 210 members, who are elected by scientists throughout Japan. The Council makes recommendations to the Japanese government about science (both cultural and natural) for the welfare of the nation. The Council's main effort is to support and encourage scientific progress. The Council considers it particularly important to encourage a high level of scientific exchange. He pointed out that Japanese scientists cannot be present in great numbers at international conferences in Europe and America because of geography. The present conference is a valuable opportunity for Japanese scientists to take advantage of contacts with their international colleagues. He asked the members of the conference to look into the scientific achievements of Japan, to learn something of the culture and social customs of Japan, and to help sponsor mutual understanding and world peace.

Dr. Takayanagi gave an account of the formation of the Society for Atomic Collision Research (Japan) and the important role played by that society in the present conference. He stated that the conference was supported by the Japanese Government as well as by industrial sponsors.

J. Kistemaker than gave the one-hour opening lecture, entitled "Twenty-five years of atomic and molecular physics." Although the 25-year period began in 1954, even earlier work was discussed. The contributions of Ramsauer and Kollath, Tate and Smith, Massey and Smith, and Bleakney in the thirties were identified as the beginning of collision physics. The development of atomic beams by Stern and Gerlach, leading to the work of Rabi and Kusch, was mentioned as giving rise to the present work of B. Bederson. The theoretical work (also in the thirties) of Born and Oppenheimer, Landau, Zener, Stueckelberg, and Franck and Condon, as well as the work of the Leningrad school of Frank and Ioffe, were mentioned.

In 1935, nuclear physics grabbed the interest of physicists, and activity in atomic physics declined. However, in the early fifties, there was a real upheaval, thanks to Massey and Burhop's book, "Electronic and Ionic Impact Phenomena," (1952). They pointed out, to the surprise of spectroscopists, that there was more to spectroscopy than the determination of energy levels, and that there was some value in knowing the chance that a given level is excited.[3]

Cross-section measurements started in earnest in the early fifties, and this was characterized as the primitive age of collision work, the beginning of the 25 years of collision work covered by Kistemaker's opening lecture.

The cross-beam work of Fite[4] was mentioned. Fite measured cross sections for production of Lyman-Alpha radiation from hydrogen atoms for electrons up to 250ev. It was pointed out that it was difficult to work with hydrogen atoms and difficult to selectively detect Lyman-alpha radiation. The use of iodine-filled Geiger-Müller counters with O_2 absorption for detection was mentioned. Fite's curve was displayed, and it was mentioned that this was not an absolute measurement but was normalized to the Born approximation at energies above 250 ev. Some of the other work mentioned was: the lack of agreement with theory at low energy of the forward scattering of electrons by atoms (Gerjuoy and Krall, 1960, 1962); measurement of electron spin exchange in the system electron + potassium and the observation that excitation can occur with the spin flip (Bederson, 1972); the discovery of a 10-millielectron-volt-wide dip in the electron-helium cross section (previously undetected because of the narrowness of the resonance) (Schulz, 1963) and theoretical explanation of this as a Feshbach resonance in the following year (Burke and Schey); closed-shell excitation and core-excited resonances (Fano, Simpson, 1963); differential cross-section measurements of energetic electrons scattered by He (Oda); threshold ionization cross section measurements of He (Read, 1974) and agreement with Wannier's prediction (1953); calculation of electron-helium cross sections with computers (Nesbet); observation of negative neon states of 10^{-13} s lifetime (Read); heavy particle physics with ions being scattered by neutrals, excitation and charge exchange (Hasted, Massey, 1950-60); the capture of an electron from a hydrogen atom by He^{++} with the electron landing in the 2S or 2P state (Fite), and the theory of this process (Basu); the effect of charge exchange in producing oscillatory differential cross sections at a given scattering angle as a function of energy of H^+ interacting with H (Everhart, 1960); influence of nuclear isotope on the charge exchange of the following processes $^4He^+ + {}^3He \rightarrow {}^4He + {}^3He^+$ and $^4He^+ + {}^4He \rightarrow {}^4He + {}^4He^+$ (Peterson, Smith, 1965); the study of electron transfer from neutral A to Ne^{4+} to give $Ne^{3+} + A^+$ (de Heer); cross sections for excitation of K-shell ionization by proton impact (Afrosimov, 1955-60); inner-shell ionization by ions (Fano and Lichten, 1965; Barat and Lichten, 1972).

M. Inokuti (educated in Japan, now working at Argonne National Laboratory, U.S.) gave an invited paper "Atomic processes in radiation physics." The motivation of this paper was to review one of the applications of the results of collision cross-section research. The paper stressed that electron collisions are the important processes in understanding the interaction of radiation on matter. The kinds of problems that Dr. Inokuti spoke of are illustrated by the following: (1) 10-kilovolt electrons are injected into gaseous hydrogen, and (2) 5-Mev protons are ejected into water vapor. How does the energy of the injected particle get distributed, what radiation is emitted, and how much ionization is produced? (These are very old questions dating from the study of the ranges of alpha, beta, and gamma rays.) How does one go about answering such questions without doing the experiment using experimental and theoretical studies of the collision physics community? Dr. Inokuti pointed out that all major excited states should be identified and cross sections for all major processes should be known. Bookkeeping must be carried out, following the energy flow into various processes and product particles and photons, as the primary particle loses energy. Dr. Inokuti pointed out that cross sections (1) should be correct,

but often they are discordant; (2) should be absolute, but often they are relative; and (3) should be comprehensive but often they are fragmentary. Dr. Inokuti reviewed Platzman's 1950 "strategy" of how to obtain good cross sections: (1) know data sources (largely experimental); (2) use all known theoretical criteria and constraints; (3) use systematics (e.g., how does He differ from Ne, etc.); (4) ask oneself why a data set is wrong; and (5) develop new theoretical constraints. Dr. Inokuti is also interested in the electronic excitation of chemical and biological processes.

Review talks were scheduled without conflicts so that all could attend. Seven such talks were given. The titles and speakers were "Drift tube technique in ion-neutral collisions," Y. Kaneko (Tokyo Metropolitan University, Japan); "Atomic physics with synchrotron radiation," F. Wuilleumier (University of Paris-Sud, Orsay, France); "Inelastic ion-atom collisions (inner-shell)," P. Richard, (Kansas State University, U.S.); "Studies of H^- resonances in an electric field," H. C. Bryant (University of New Mexico, U.S.); "Electron-molecule scattering," A. Temkin (NASA/Greenbelt, U.S.); "(e,2e) spectroscopy," E. Weigold (Flinders University of South Australia, South Australia); and "Atomic collision processes and UV and soft x-ray lasers," I. Sobel'man (Lebedev Physical Institute, U.S.S.R.).

Kaneko's address discussed the use of ion drift tubes to study various charge exchange reactions at very-low energy (a few hundredths of an electron volt and above). Ions are produced in a conventional ion source, mass-analyzed and decelerated down to about 20 ev before getting into the drift tube. The ions getting out of the drift tube are mass-analyzed again and reaction cross sections are determined. The average collision energy is calculated from the measurement of the ion drift velocity by Wannier's formula. Some of the cross sections discussed were those of the following reactions

$$(1)\ O^+ + CO_2 \rightarrow O_2^+ + CO;$$
$$(2)\ Ne^+ + Ne \rightarrow Ne + Ne^+;$$
$$(3)\ Ar^+ + NO \rightarrow Ar + NO^+;$$
$$(4)\ Ar^+ + O_2 \rightarrow Ar + O_2^+;$$
$$(5)\ O^+ + N_2 \rightarrow NO^+ + N;$$
$$(6)\ Xe^{++} + Xe \rightarrow Xe + Xe^{++};$$
$$(7)\ Kr^{++} + Kr \rightarrow Kr + Kr^{++}.$$

He reviewed the fact that the measurement of ionic mobilities gives a useful and powerful method of obtaining ion-atom interaction potentials. The advantages of drift tube studies were listed as (1) attainment of the low energy-regime 0.01 ev $< E <$ 10 ev; (2) measurement of integral rather than differential cross sections; (3) high sensitivity (cross sections of around 10^{-18} cm^2 can be measured); and (4) the relatively easy experiments. The disadvantage is the distribution in energy of the ions studied.[5]

Wuilleumier's review paper emphasized the relatively recent and widespread use of synchrotron radiation for photoionization studies. (A considerable number of contributed papers reported studies using synchrotron radiation from the facilities at Orsay, Bonn, University of Tokyo, and the Stanford Synchrotron Radiation Laboratory). Intense radiation of any wavelength can be selected. The synchrotron also provides polarized radiation which is useful in photoionization studies.

Seventeen progress reports were given in parallel sessions. Titles and authors follow:

"Intermediate and super-heavy atomic collision systems; experiments at the UNILAC," D. Liesen (GSI, Germany)

"Systematics of multiple ionization in heavy ion collisions," Y. Awaya (Institute of Physical and Chemical Research, Wako-shi, Japan)

"Simultaneous excitation of heavy nucleus and K-shell by protons," J. F. Chemin (University of Bordeaux, France)

"Electron-ion collision experiments," J. William McGowan (University of Western Ontario, Canada)

"Electron attachment to molecules," R. N. Compton (Oak Ridge National Laboratory, U.S.)

"Optical polarization studies in molecules following electron impact," J. W. McConkey (University of Windsor, Canada)

"Inner-shell excitation of atoms and molecules by electron impact," M. J. van der Wiel (FOM–Institute for Atomic and Molecular Physics, The Netherlands)

"Threshold e^--photon-ion coincidence," P. M. Guyon (University of Paris-Sud, France)

"Shape-resonance-enhanced nuclear motion effects in electron-molecule scattering and molecular photoionization," J. L. Dehmer (Argonne National Laboratory, U.S.) and D. Dill (Boston University, U.S.)

"Electron spectrometric studies of ionizing thermal energy collisions involving excited atoms," H. Hotop (University of Kiel, Germany)

"Merging-beam experiments with excited atoms," R. H. Neynaber (IRT Corporation, U.S.)

"Analysis of atomic photoionization using relativistic random phase approximation and multichannel quantum defect theory," W. R. Johnson (University of Notre Dame, U.S.)

"Electron-molecule resonances as intermediates in dynamic processes," H. S. Taylor (University of Southern California, U.S.)

"Radiative processes in collisions involving strongly bound quasimolecular states–positron emission," J. S. Greenberg (Yale University, U.S.)

"Positrons and other messengers from superheavy quasi-atoms: a theoretical survey," B. Müller (University of Frankfurt, West Germany)

"Collision studies of quasi-one-electron systems," N. O. Andersen (H. C. Ørsted Institute, Denmark)

"Spin dependent effects in electron-atom collisions: theory," V. D. Ob'edkov (Leningrad State University, U.S.S.R.).

Eight symposia were presented with as few as four papers or as many as seven in any one symposium. The titles of the symposia follow:

"Electron capture by multiply-charged ions"

"New experimental techniques" (lasers, high-resolution electron spectroscopy, pulsed molecular beam experiments, techniques for production of quantum-state-selected atomic and molecular beams, channel-plate techniques in beam experiments)

"Theoretical methods"

"Rydberg states of atoms and molecules" (electron collisions with Rydberg atoms, collisions of Rydberg atoms with ground-state atoms and with photons, collisions of Rydberg atoms with molecules, theory of thermal collisions between high-Rydberg atoms and neutral species)

"State-resolved atom(ion)-molecule ro-vibrationally inelastic and reactive scattering" (laser fluoresence

measurements of integrated cross section for rotational transitions of state-selected lithium hydride and of differential cross sections for rotational transitions of Na_2, energy loss studies of rotational and vibrational excitation in proton-molecule scattering, state-selected reactive collisions of diatomic molecular ions by a coincidence technique)

"Amplitudes and state parameters in atomic collisions" (angular correlations in atomic physics, coherent and incoherent processes in atomic collisions, excitation of autoionizing states in heavy particle collisions studied by ion-electron angular correlations)

"Electron detachment in negative ion collisions"

"Atomic and molecular collision processes under the influence of strong radiation fields."

The subjects mentioned above give a good idea of the contents of the some 500 papers presented in poster sessions.

What amazing changes in emphases, techniques, and energy range from the first conference 21 years ago! And how theorists have improved their presentations from the purely formal analytical step-by-step presentations 21 years ago!

It may be interesting to note that the following papers were given by ONR contractors

"Recent developments in laser spectroscopy," A. Schawlow (Stanford University) (invited paper)

"Resonance partial widths and partial photoionization rates using the rotated coordinate method," T. Noro, H. S. Taylor, and R. Yaris (University of Southern California)

"Application of the many body theory to elastic and inelastic scattering of electrons off helium and other rare gas atoms," T. Scott, H. S. Taylor, and P. Driessen (University of Southern California)

"Electron-molecule resonances as intermediates in dynamic processes," H. S. Taylor (University of Southern California) (progress report)

"Penning and associative ionization in the metastable argon-metastable krypton system," R. N. Neynaber and S. Y. Tang (IRT Corporation)

"Merging-beam experiments with excited atoms," R. N. Neynaber (IRT Corporation) (progress report)

"Nonsingular variational principle for the scattering length for the target wave function imprecisely known," L. Rosenberg and L. Spruch (New York University)

"The $H^+ + CH_4 \rightarrow H_2^+ + CH_3$ process in the double scattering model," R. Shakeshaft and L. Spruch (New York University)

"Study of optical emission in collisions of He^* with atomic and molecular targets," M. Coggiola, T. Gaily, K. T. Gillen, and J. R. Peterson (SRI International)

"Target dependences for continuum capture processes in ion-atom collisions," C. R. Vane, I. A. Sellin, M. Suter, S. B. Elston, G. D. Alton, and R. S. Thoe (University of Tennessee and Oak Ridge National Laboratory) and R. Laubert (East Carolina University)

"Coincidence experiments concerning forward electron ejection," I. A. Sellin, M. Suter, C. R. Vane, S. B. Elston, R. S. Thoe, and G. D. Alton (University of Tennessee and Oak Ridge National Laboratory)

"K-Auger electrons observed in coincidence with final projectile charge state in ion-atom collisions," M. Suter, C. R. Vane, S. B. Elston, I. A. Sellin, R. S. Thoe and G. D. Alton (University of Tennessee and Oak Ridge National Laboratory)

"Measurements of single-electron charge transfer between doubly charged ions and atoms or molecules at thermal energies," R. Johnsen and M. A. Biondi (University of Pittsburgh)

"A consistent set of electron collision cross sections for N_2*," A. V. Phelps, D. Levron, and K. Tachibana (Joint Institute for Laboratory Astrophysics, University of Colorado, and National Bureau of Standards)

"A new variational technique for the complex coordinate method," B. R. Junker (Office of Naval Research)

XII ICPEAC will be held 15-21 July, 1981 at Gatlinburg, Tennessee. The new officers are chairman, R. F. Stebbings, U.S.; vice chairman, F. Read, UK; secretary, J. S. Risley, U.S.; treasurer, G. Watel, France. The local chairman will be S. Datz. Berlin has been proposed for the XIII ICPEAC location with 27 July-2 August, 1983, as possible dates.

Five two-day satellite meetings were held immediately after XI ICPEAC. The names of the meetings and places where they were held (as well as the names and addresses of the organizers, in case any one wishes to write for proceedings) follow:

- VIth International Seminar on Ion-Atom Collisions, Tokai
  Dr. Y. Nakai, Nuclear Data Center
  Tokai Research Establishment
  Japan Atomic Energy Research Institute
  Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan

- Symposium on Electron-Molecule Collisions, Tokyo
  Dr. I. Shimamura
  Institute of Space and Aeronautical Science
  University of Tokyo
  Komaba, Meguro-ku, Tokyo 153, Japan

- Nagoya Seminar on Atomic Processes in Fusion Plasmas, Nagoya
  Dr. S. Ohtani
  Institute of Plasma Physics
  Nagoya University
  Chikusa-ku, Nagoya 464, Japan

- Symposium on the Dynamics of Molecular Collisions, Okazaki
  Professor K. Kuchitsu
  Department of Chemistry, Faculty of Science
  University of Tokyo
  Bunkyo-ku, Tokyo 113, Japan

- International Seminar on Swarm Experiments in Atomic Collision Research, Tokyo
  Professor I. Ogawa
  Department of Physics, Faculty of Science
  Rikkyo University
  Nishi-Ikebukuro, Toshima-ku
  Tokyo 171, Japan

I attended the last-named satellite meeting, which was attended by about 30 people. R. W. Crompton and S. C. Haydon of Australia, and A. V. Phelps, M. A. Biondi, L. C. Pitchford (and I) of the U.S. were the non-Japanese attendees. A full two-day series of papers by Japanese workers and one by Pitchford as well as invited papers by Haydon, Crompton, Phelps, and Biondi comprised the program. The papers covered the topics of electron attachment, determination of electron collision cross sections from swarm data, electron drift velocity measurements, ratio of diffusion coefficient to mobility for electrons in liquid argon, etc., ion-molecule collision and reaction studies by various swarm techniques, positive ion mobilities, spectroscopy of excited atoms and molecules in glow discharges and afterglows, and Boltzmann analysis of swarm experiments. Thus Japan has a viable activity in swarm physics.

Readers of this report may be interested to know that, on 23-25 August 1979, a symposium on Atomic and Molecular Science was held in Taipei, Republic of China. This meeting was sponsored by the National Science Council and Ministry of Education, Republic of China. The opening address was given by J. P. Toennies, Max-Planck-Institut für Strömungsforschung, Göttingen "The importance of molecular science in future technology." Overview talks were given by R. T. Poe, University of California, Riverside, "Recent progress in the physics of highly excited atomic Rydberg states," and S. Trajmar, Jet Propulsion Laboratory, "Electron-atom/molecule collision processes at low- and intermediate-impact energies." Titles and authors of other papers follow:

"Studies on pair production and on photo-production," (invited paper), H. K. Tseng (National Central University)

"A two-potential approach for electron-molecule collisions at intermediate and high energies," (invited paper), Y. Shan (National Tsing Hua University)

"Atomic and molecular processes in planetary atmospheres," D. Cartwright (Los Alamos Scientific Laboratory)

"A hyperfine structure calculation on muonic helium," J. C. Sun, J. J. Lu, and R. T. Poe (University of California, Riverside) and Y. Shan (National Tsing Hua University)

"The ratios of K-vacancy production cross section of copper by the bombardment of equal-velocity deuterons and alpha particles," C. N. Chang, Y. C. Liu, S. L. Huang, and S. C. Yeh (National Tsing Hua University)

"Electron capture of hydrogen by μ^+ and e^+," C. S. Hsue and M. K. Chen (National Tsing Hua University) and C. D. Lin (Kansas State University)

"Electron capture from silicon and germanium foils by protons," C. C. Wei and W. S. Hus (National Tsing Hua University)

"Resonance phenomena in reactive scattering," Y. T. Lee (University of California, Berkeley)

"A theoretical study of $D + H_2 \rightarrow DH + H$ reactions," K. T. Tang (Pacific Lutheran University) and B. H. Choi, R. T. Poe, and J. C. Sun (University of California, Riverside)

"A simple model for charge exchange process in the mixed-valence systems," S. L. Lee and S. Y. Chu (National Tsing Hua University)

"Associative ionization of ground state species," W. L. Fite (University of Pittsburgh)

"Laser research at Chung-Shan Institute of Science and Technology," (progress report), T. C. Wang (Institute of Nuclear Energy Research)

"Laser physics at National Tsing Hua University," J. T. Lue (National Tsing Hua University)

"Quasienergy formalism for intense field processes," (invited talk), S. I. Chu (University of Kansas)

"Laser-assisted charge-transfer processes," C. L. Tang, R. Tkach, N. Dutta, and H. Mahr (Cornell University)

"A practical nitrogen laser," L. I. Kun, T. C. Wang, S. T. Chiang, W. S. Lee, and S. H. Chang (Institute of Nuclear Energy Research)

"Elliptically polarized optical pulse propagation in a degenerate two-level medium," S. Chi (National Chiao Tung University)

"The selective excitation of gaseous molecules by laser light," H. Chang (National Tsing Hua University)

"The optimization of an optically pumped Nd: Yag: laser by a Z-pinch discharge flash lamp," D. Y. Song and J. T. Lue (National Tsing Hua University) and C. K. Yeh (Institute of Nuclear Energy Research)

"Electron-atom scattering in laser fields," S. Trajmar (Jet Propulsion Laboratory)

"Ejection of neutral atoms by laser induced optical breakdown plasma," M. R. Wang and H. C. Meng (Institute of Nuclear Energy Research)

"Laser and non-linear optics in atomic/molecular physics," (overview talk), C. L. Tang (Cornell University)

"Atomic research in laser fusion, laser isotope separation and exotic problems," D. C. Cartwright (Los Alamos Scientific Laboratory)

"Ion-neutral interaction and applications," W. L. Fite (University of Pittsburgh)

"Energy-transfer processes in atom-molecule collisions," K. T. Tang (Pacific Lutheran University)

"Current problems in atomic inner-shell physics," B. Crasemann (University of Oregon)

"Recent progress on the study of man-body effects in atomic transitions," T. N. Chang (University of Southern California)

"Laser enhancement of chemical reactions," W. Miller, (University of California, Berkeley)

"Dynamics of multiphoton excitation processes," Y. T. Lee (University of California, Berkeley)

"Molecular research at National Taiwan University," K. C. Lin (National Taiwan University)

"Molecular research at National Tsing Hua University," S. Y. Chu (National Tsing Hua University)

"Resonances in electron-hydrogen atom scattering," (invited talk), C. D. Lin (Kansas State University)

"An SCF/agorithm for metastable states," T. C. Chang, (National Cheng Kung University)

"Classical differential cross sections for anisotropic potentials," F. E. Budenholzer, E. A. Gislason, and P. M. Polak-Dingels (Fu Jen University)

"The perturbation order analysis of the orbital correlation diagrammatic topology," T. S. Lee and S. Y. Chu (National Tsing Hua University)

"Laser research at National Chiao Tung University," (progress report), K. C. Huang (National Chiao Tung University)

"Laser chemistry at National Tsing Hua University," (progress report), H. Chang (National Tsing Hua University)

"Relativistic radiationless transitions in atoms," (invited talk), M. H. Chen (University of Oregon)

"On the fine structure of the highly excited Rydberg states of alakali atoms," T. N. Chang (University of Southern California)

"A numerical solution of eigenvalue-eigenvector in the Hilbert space–a generalized variation theory and a new numerical method for the solution of eigenvalue-eigenvector equation with a distance measure in a pattern space," C. H. Lin and C. C. Su (National Cheng Kung University)

"Applications of synchrotron radiation in atomic physics," B. Crasemann (University of Oregon)

It is interesting to note that a number of non-Taiwan speakers at the Taipei meeting attended and presented papers at XI ICPEAC. There were no attendees at XI ICPEAC from Taiwan, although some of the subjects which Taiwanese speakers covered would have been suitable for presentation at Kyoto.

FOOTNOTES

[1]The Society for Atomic Collision Research (Japan) was formed in 1976. The Society is devoted to the promotion of atomic collision research in Japan through the exchange of information among scientists in this field and other closely related fields. Another purpose of the Society is to promote international cooperation. The Society considers the organizing of XI ICPEAC its first activity in international cooperation. The Society had 290 members at the beginning of 1977 and at present has 350 members. At the conference, copies of three publications (all in English) were made available to the participants which reflect the activity of the Society. They are "Studies of Atomic Collisions and Related Topics in Japan," Progress Report No. 3, March 1977 (180 pages); "Atomic Collision Research in Japan–Progress Report–(Continuation of 'Studies of Atomic Collisions and Related Topics in Japan')," No. 4, 1978 (157 pages) and No. 5, 1979 (165 pages). Nos. 4 and 5 carry the imprimatur of The Society for Atomic Collision Research. Reports were also issued in 1971 and 1974. Some of the work reported in these publications had already been published in scientific journals, some had been submitted for publication, while other work was still in progress. Progress Report No. 3 contains a list of 71 research groups in atomic collisions in Japan along with the names of the research workers. The Society holds meetings: its first scientific meeting was held in July, 1977, and its second in July, 1979. Readers wishing further information about the Society or who would like copies (if available) of the above publications should write to Professor K. Takayanagi, chairman of The Society for Atomic Collision Research, c/o Institute of Space and Aeronautical Science, University of Tokyo, Komaba 4-6-1, Meguro-ku, Tokyo 153 Japan. (Another group of scientists and engineers has formed the "Japan Research Group of Electrical Discharges" (JRED). The group consists of 350 people. On 8 September an all-day meeting of six papers was held by the group on "Instability and Form Transition in Electrical Discharge" at the Nihon University in Tokyo. Anyone wishing information about JRED may write to Dr. Makoto Hayashi, Nagoya Institute of Technology, Gokiso-cho, Showa-ku, Nagoya, 466, Japan)

[2]The 1977 Annual Report of the Science Council of Japan (in English) is available. The address of the Council is 22-34, Roppongi 7-chome, Minato-ku, Tokyo 106 Japan.

[3]Massey and Burhop's book was the first systematic review of experimental-collision phenomena by masters of quantum mechanics. The book also reviewed swarm experiments.

[4]The names referred to by Kistemaker throughout are the "principal" investigators. Names of co-workers were generally not mentioned in accord with the rather unfortunate "star" syndrome in science.

[5]Measurements of mobilities of ions in gases goes back to the end of the last century, and theoretical analysis of interaction of ions and atoms from mobility experiments goes back to Langevin in 1905. However, until rather recently, the identities of the ions whose mobilities were measured were uncertain. Great progress has been made with the help of mass spectrometers in connection with mobility studies. Thus, an old kind of measurement is being used to study all kinds of ion-molecule/atom reactions.

MARINE SCIENCE IN THE ASEAN COUNTRIES

Francis A. Richards

ASEAN, the Association of Southeast Asian Nations, is a loose confederation consisting of Thailand, Malaysia, Singapore, Indonesia, and the Philippines, formed for their mutual benefit in matters of trade, culture, and other areas, including scientific information exchange.

These are all developing countries, and their activities in marine science are necessarily oriented toward practical matters: aquaculture, marine resources, commerce, and protection of the environment. Nonetheless, there are in these countries dedicated and well-informed scientists who realize the long-range importance of basic research and the need for fundamental education in the marine sciences. Many of the scientists in influential positions have been educated in Europe, North America, and Japan, and have a good understanding of the requirements of marine research. In most of the institutions I visited, however, there was an acute awareness of the lack of resources that could be dedicated to research—either pure or applied. Most of the people holding advanced degrees from other countries have quickly risen to positions of administrative importance, in which they find themselves with meager bases of staff and facilities to carry out research. Much of their effort is, wisely, dedicated to education; it is my opinion that this bootstrap effort is already showing good returns. In a few years, these nations should begin to realize significant returns for their investments in education.

In a broad overview, most of the countries have active governmental fisheries agencies dedicated to both traditional fisheries and to aquaculture. There is a growing awareness of the threat of pollution to marine resources and also of unbridled fishing practices, such as the overfishing of stocks and the unprincipled practice of dynamite fishing, which kills not only the wanted species but most of the organisms in the food web, including corals. In these countries not much effort can be afforded for "pure" oceanographic research, yet Indonesia has plans for a "*Snellius* II" oceanographic expedition designed to reinvestigate water mass exchanges among the Indonesian basins with more modern methods than were available to the first *Snellius* expedition in 1929 and 1930.

THAILAND

My interviews in Bangkok were arranged by my old friend, Dr. Manuwadi (Tongudai) Hungspreugs. She is a marine chemist who took her D. Sc. under the direction of Professor J. P. Riley at the University of Liverpool; her research at Liverpool was on the major constituents of seawater. Since her return to Bangkok, she has been on the faculty of Chulalongkorn University, and she is now head of the Department of Marine Science, which was formed in 1968. The department is the only one in Thailand that can offer degrees in physical and chemical studies of the ocean. Three options are available: marine biology and fisheries, physical and chemical oceanography, and marine science. In 1973 master's degree programs in marine biology and fisheries or in chemical and physical oceanography were set up. There are 13 on the teaching staff; five have doctor's degrees—from Liverpool, Helsinki, Washington, and two from Hawaii. Two others have master's degrees from foreign universities and five hold this degree from Chulalongkorn. Five to 10 new graduate students are admitted annually, so there is a "standing crop" of around 25. The master's program requires 30 hours of course work and 18 hours of thesis work beyond the B. Sc.

The main areas of research in the department are taxonomy, mostly of marine invertebrates, but fish larval studies are being initiated; experimental marine biology; coastal mariculture; behavior of marine animals; marine chemistry and pollution; and the physical oceanography of estuaries. Specific research areas have included:

1) Pollution of Thai marine waters,
2) Effects of temperature changes on some organisms in the Gulf of Thailand,
3) The estuarine ecosystem of Pang Nga Bay,
4) Reproduction, nutrition, and tolerance of giant freshwater prawns (*Macrobrachium rosenbergii*),
5) Studies on the biological assimilation of organochlorine compounds, using radioactive tracer methods,
6) Studies of monthly variations of sea-surface temperatures in the northern Indian Ocean and South China Sea, using NOAA satellite data,
7) Causes of the mortality of blood clams at the mouth of the Mae Klong river,
8) Petroleum-derived normal paraffins in the seawater and sediments of the Gulf of Thailand,
9) Chlorinated hydrocarbons, polychlorinated biphenyls (PCB's), and some heavy metals in oysters from the Gulf of Thailand,
10) Comparative studies of some pollutants in the Gulf of Thailand and the Andaman Sea, and
11) The accumulation of heavy metals in marine organisms in the upper Gulf of Thailand.

The facilities of the department include 2000 square meters of classrooms, laboratories, and offices in the new science building, in which there is a small, closed circulating seawater system. There are biological and chemical laboratories, and laboratories for physical and geological oceanography are planned. The department operates a brackish water station at Ang Sila, about 100 km from Bangkok, which can accommodate 30 people at a time; it includes classrooms and open- and closed-system saltwater aquaria. A marine science center is to be located on Si Chang Island, about 10 km offshore from Sri Racha, Cholburi. The location has clean seawater with nearly constant salinity.

The department has only a small outboard motor boat and has to rely on a fisheries research vessel for training students and research. The Thai Navy conducts hydrographic surveys, but their boat is too small for research or training. The departmental equipment includes a gas chromatograph, spectrophotometer, atomic absorption spectrometer, a mercury analyzer, a Gilson respirometer, an osmometer, a scintillation counter, spectrofluorometer, a salinometer, current meter, bottom samplers, salinity-temperature-depth recorder (STD), and an echo sounder.

The Faculty of Fisheries of Kasetsart University was founded in 1943 and first awarded the degree of Bachelor of Science in Fisheries in 1955. The faculty has five departments: aquaculture, fishery biology, fishery management, fishery products, and marine science.

The department of marine science "aims to give students a broad background of basic marine science together with an awareness of social philosophy." The bachelor's curriculum looks much like ours at the University of Washington, with courses in the basic sciences and mathematics, 27 semester credits in the social sciences, and 80 in "professional and major" subjects. The M.S. degree requires an additional 36 semester credits of course work and six credits of thesis work. Some fisheries courses are included as well as a course in coastal navigation. However, the physical oceanography courses are taught at Chulalongkorn.

The head of the department is Mahn Bhovichitra, who has his Ph.D. from the University of Rhode Island, where his research supervisor was Professor Theodore J. Smayda. The department includes four assistant professors, two with Ph.D. degrees, six junior lecturers (one with a Ph.D., three with their M.S.) and one instructor. The facilities include two fisheries training stations, which are also used for research in coastal aquaculture. They are at Sriracha and Klong Wan.

Most of the research in the department is concerned with coastal aquaculture. One of the projects concerns eyestalk ablation in shrimp, of interest because a hormone produced in the eyestalk induces molting. Phytoplankton studies are carried out in connection with oyster culture work—at many river mouths in the Gulf of Thailand, there are many flagellates that are unsuitable food organisms for oysters. The phytoplankton studies include sampling, identification and classification, pigment analyses, and general phytoplankton ecology. Other field work includes water sample collections in the Gulf of Thailand for four or five days, twice a year, for

pollution studies. This is an interdepartmental, cooperative project sponsored by the Thai Government and the Thai National Research Council; the project covers most branches of marine science.

Within the Thai Department of Fisheries, the Deputy Director General for Technological Matters oversees freshwater, brackish water, and marine fisheries divisions as well as divisions devoted to fishery technology development and exploratory fishing. The freshwater, brackish water, and marine fisheries divisions all operate fishery stations located outside Bangkok; the marine fisheries division also operates the Phuket Marine Biological Center. The fishery stations operate somewhat as do our agricultural stations; they carry out extension work and training, supervise fish farmers study and advise on the layout and construction of ponds and pond systems, carry out experiments and demonstrations on culture practices, and identify suitable areas for the future culture of specific species. Thailand has a very large potential area for the brackish water culture of shrimp, fish, mussels, cockles, and oysters. Some 100,000 hectares could be developed for these activities, with the remainder of the undeveloped area being converted to agriculture. Shrimp culture is now the main activity, but there is a potential for the development of over 60,000 hectares for the culture of fish, one of the most important species being the sea bass, *Lates calcalifer*.

In addition to the aquaculture resources survey work, the brackish water division, which is under the direction of Mr. Umpol Pongsuwana, carries out research on parasite and disease control, and feed and nutrition studies. Finding suitable, cheap local feed is important to the development of aquaculture here as well as elsewhere in Southeast Asia.

The hydrographic data necessary for the function of the brackish water division are gathered by the Thai Navy; the hydrographic office publishes their data annually. The Navy operates a 400-ton oceanographic survey ship, converted from a fishing boat. Soil condition and water quality are made available by the survey section of the division for use by the research section.

The division of marine fisheries has a marine laboratory and pelagic, demersal, and invertebrate fisheries sections. The director is Dr. Deb Manasveta. The marine laboratory is concerned mainly with marine ecology and the environment. They conduct base line studies and monitor water quality, the benthos, plankton abundance, and primary productivity. The water quality observations include routine salinity, temperature, dissolved oxygen, nutrient, and chlorophyll a, b, and c observations in and around the Gulf of Thailand. They are also tracing pollutants by following biochemical oxygen demand (BOD) and dissolved oxygen; they are starting a program of observing heavy metals, polychlorinated biphenyls (PCB), pesticides, and oil. To carry out these analyses, the division has acquired a Perkin-Elmer atomic absorption spectrometer with tubes for the estimation of sodium, lead, zinc, and copper. They also have a Coleman mercury analyzer system. Primary productivity estimates are largely based on light and dark bottle experiments; the cost of carbon-14 fixation experiments presents a problem. Some such determination have been made at the Phuket Marine Biological Center, sending the samples to Copenhagen for the carbon-14 counting.

Plankton studies include assessments of plankton abundance, species composition, and distribution in the Gulf of Thailand. An important part of the work of the laboratory is investigating the role of plankton as food for aquaculture organisms. One specific study is concerned with the relationship of mouth size to the size of food organisms during larval feeding. As part of these studies, 17 phytoplankton species are now under culture in the laboratory: *Chlorella* T, S, and A; *Chaetoceros calcitrans; Cyclotella* sp.; *Clamydomonas* sp.; *Platymonas* sp.; *Skeletonema* S and T; *Tetraselmis* sp.; *Isochrysis* sp.; *Thalassiosira* sp.; *Cyanophyta; Brachionus plicatilis; Microcyclop* sp.; *Laphonte* sp.; and *Schizopera subterranea*. Another project of the unit is to produce a zooplankton organism to substitute for the brine shrimp as a food for larval shrimp. At present, the sole source of brine shrimp (*Artemia*) eggs is Great Salt Lake, Utah. Their importation is expensive and adds significantly to the cost of cultured shrimp larvae.

The pelagic fisheries section is concerned with stock assessments, life history and behavioral studies, the distribution of species, and sub-population racial identification, age and growth determination, and tagging studies. Of the many species caught off Thailand, there are some 16 major pelagic species and 12 major groups

of demersal fishes. The pelagic species are far more valuable; nearly 70% of the demersal fish taken are so-called trash fish and go into the production of fish meal. The most basic research in the pelagic fisheries section concerns the basic biology of the commercially important species, their reproductive cycles, the distribution and behavior of the eggs and larvae, and their migratory patterns. Laboratory studies are being carried out on the development of artificially fertilized Indo-Pacific mackerel and the identification of different races of fishes by blood grouping. Extensive tagging programs are used to follow migration patterns.

The invertebrate fisheries unit is concerned with both the capture and cultivation of squids, oysters, shrimp, clams, crabs, and other invertebrate species.

Generally the problems being tackled in the division of marine fisheries are common ones in Southeast Asia: pollution of the environment; overexploitation of stocks; good sources of seed animals; hatchery practices; the economical supply of nutritious diets for cultured animals; and economical and sanitary harvesting and marketing practices. A final area of common concern in this part of the world is mangrove swamp ecology and its relationship to fisheries—both cultivated and wild vertebrate and invertebrate species. In visiting laboratories in Southeast Asia one becomes aware of the economic and ecological importance of mangroves and of the increasing interest ecologists, marine biologists, and fishery scientists have in these ecosystems, many of which are being threatened by the encroachments of commercial development.

MALAYSIA

There are five national universities in Malaysia. Teaching at the National University, about 30 miles south of the capital, Kuala Lumpur, is now conducted entirely in the Malay language, and an aim of the government is the eventual conversion of all the universities to the national language. The University of Malaya, in Kuala Lumpur, is a general university founded in 1957. It has a student body of 8000 and includes faculties of medicine, dentistry, science, engineering, social sciences and arts, and economics and public administration. The Universiti of Sains Malaysia in Penang is divided into various non-departmentalized schools and has a two-year general education section, which students attend before entering one of the science schools. The University of Agriculture Malaysia is at Serdang, Selangor, and there is a University Technology Malaysia in Kuala Lumpur; it has specialties in engineering, petroleum technology, etc. Marine science activities are centered in the University Sains, University of Malaya, and the Agriculture University.

A faculty of marine sciences and fisheries at the Agriculture University is now in the formative stages within the faculty of veterinary sciences, where there are eight or ten people interested in marine science. By far the most activity (and promise) appears to be in the School of Biological Sciences of the Universiti Sains Malaysia in Penang under the leadership of Dr. Thia Eng Chua. Dr. Chua was curator of the CSK (Cooperative Studies of the Kuroshio and Adjacent Regions) plankton sorting center, formally entitled the Regional Marine Biological Centre for Southeast Asia, from 1968 to 1972. During that time the center was on the campus of the University of Singapore, where Chua was a member of the zoology department. (Note: The Sorting Center and plankton collections have now been moved to the campus of the faculty of marine science and technology, Tokai University, Orido, Shimizu-shi, Shizuoka-ken 424, Japan. The center is now called the Marine Biological Center; its director is the well-known Professor Sigeru Motoda. The collections can be made available to visiting scientists, and there are facilities at the center for studying the material.) Although Chua is still engaged in plankton studies, he has turned more and more to the problems of aquaculture, especially the culture of groupers (which turn up on Malaysian menus as garupa), shrimps, and sea bass. Another activity is his participation in studies of the multidisciplinary aspects of oil spills. A team from the School of Biological Sciences, School of Physics, and the School of Comparative Social Sciences has recently published a study, "Coastal Resources of Western Sabah, an investigation into the impact of oil spills" (published by Universiti Sains Malaysia, Penang, $20.00 Malaysian). The report is the result of a team survey of the Sabah Coast (northeastern part of the island of Borneo) and its living resources to predict the impact of an oil blowout or major oil spill, especially possible effects on fish and the fisheries, prawns and other invertebrates, marine algae, coral reefs, sea birds, the beach, rocky shores and coastal swamps, microbial degradation, oceanography, and the socioeconomics of the fishing industry. The project was sponsored by Exxon Malaysia, Inc. An even larger team effort is now being directed

toward a similar study of the eastern coast of the Malay Peninsula. Over 20 scientists are involved in the multidisciplinary study of coral reefs, hyrocarbons and their fate, fisheries and fishery economics, beaches, and mangrove swamps. This survey of living resources should be completed by the end of 1979.

Universiti Sains Malaysia was founded in 1969 with the aim of emphasizing the development of the sciences, but the social sciences and humanities are included in its curricula. The university now has an enrollment of around 3500 students and a faculty of about 350. It is divided into nine non-departmentalized schools, each headed by a dean. The campus, formerly a British army barracks, occupies a beautifully vegetated area of 250 acres. The many new and attractive buildings were funded by the World Bank.

The School of Biological Sciences operates a new marine biological field station at Muka Head, where classes are offered in November (that is the semester break; the academic year consists of two semesters, from July to October and December to March). The station has a main laboratory building and eight bungalows, which can accommodate up to 100 students. Two more bungalows are for staff. Except during November, laboratory facilities can be provided for foreign visiting scientists, whose visits must be approved by the Prime Minister's office; such visitors must report the results of their work and publications to the government.

The School of Biological Sciences offers B.Sc. degrees with single or double honors and the degree of B.Sc. in Education. M.Sc. and Ph.D. degrees are offered on the basis of research. Undergraduates select a single major subject in their final year–aquatic biology, parasitology, entomology, plant pathology, or microbiology. The school has an enrollment of around 300 undergraduate and 20 graduate students and a staff of 45 academics, 39 of whom hold doctor's degrees. The laboratories are new and spacious, and the school is quite well set up for basic research and teaching, with good, new equipment, including both transmission and scanning electron microscopes. Student research projects are in the areas of aquaculture; fish biology; planktology; pesticide, PCB, heavy metal and oil pollution; and the reproductive physiology of fishes.

The university has no research vessels and relies on charters of local boats. In addition, the Fisheries Department has a "research" vessel in each state, but these are multipurpose vessels used as patrol boats, for surveying, for carrying passengers, etc.; the implication is that they are not very reliable platforms for scientific research. The Malaysian Navy operates one hydrographic vessel; its principal mission is to supply data, most of which the government considers to be classified, to permit predictions of wind speeds, wind directions, and current speeds and direction. From time to time the data may be made available to the university upon request.

The library resources of the school are rather limited, and exchanges with foreign libraries are desired. Principal Malaysian publications are the *Fishery Bulletin of the Ministry of Agriculture and Rural Development, Malayan Nature Journal,* and the *Malaysian Agricultural Journal.*

The campus of the University of Malaya is spread out over several hundred acres of beautiful rolling hills on the outskirts of Kuala Lumpur. A few scientists at the university are interested in marine research, and others have tentative plans for marine, generally coastal and estuarine, work. The head of the Geology Department, Dr. Charles S. Hutchison, is considering some projects for geological studies of tidal flats and estuaries, but the work has not begun. Dr. N. S. Haile was interested in marine geology, geophysics, sedimentology, and paleomagnetism, but he has retired and is no longer active in the field. Dr. Hutchison's principal interest is in rock geochemistry. Samples are collected from the surface of the ground, stream beds, river banks, and auger borings. The department has an atomic absorption spectrometer and an emission spectrograph for rock analyses. The geochemical properties of rock samples are plotted on contour maps in order to pinpoint anomalous areas.

Dr. A. Sasekumar of the Zoology Department is interested in the ecology and productivity of mangrove swamps. These environments are very important to coastal fisheries, serving as nursery grounds for juvenile prawns until the sub-adults move out of the swamps. At high tide fish enter the mangroves and feed on various invertebrates such as crabs and snails. Mangrove trees are used to burn into charcoal, in some places tannin is produced from them, and they are also used as pilings in soft soil. However, the main threat to the mangroves

comes from the reclamation of the land for coconut plantations. They are also threatened by pollution, especially by the organic effluents dumped by palm oil factories.

Sasekumar has been working on mangrove ecology for eight or nine years. He is interested in the macrofauna and the meiofauna. He samples simple ecological quadrats using a 2-cm diameter brass corer. The animals are separated by sieving, identified, and counted. The data are used to prepare abundance maps. The total meiofauna, composed mostly of nematodes, harpacticoid copepods, kinorhynchs (which are very abundant), and oligochaetes, vary from around 1200 per square centimeter in the seaward shore to around 500 per square centimeter on the higher shores. About 80% are free-living nematodes, oligochaetes, etc. These animals are important in the food web because many of the mangrove animals feed on the mud and are in turn fed upon by fish. The mangrove studies also include estimates of primary (photosynthetic) production of organic matter by the systems. Although most of the productivity is attributable to the mangroves themselves, algae and diatoms are also important producers. Although not much work has been done on nutrient cycles, Sasekumar recognizes the importance of such work and would like to begin nutrient observations, but he is hampered by the lack of equipment, supplies, and personnel.

Within Sasekumar's group there are graduate and senior honors students. The latter do small research projects that are completed in six months. Some of the subjects of recent projects have been: trophic levels of coastal fish; the ecology of a sandy shore; the study of a transect of a mangrove swamp. One graduate student has made a study of the productivity of mangrove crabs—most of which are fiddlers.

Several foreign visitors have made studies of the coastal zone in Malaysia. One such visitor worked for three years on the production of the edible cockle *Anadara granosa* and a Sri Lankan visitor carried out research on marine fishes and the aquaculture of the freshwater prawn, *Macrobrachium rosenbergi*, which breeds in estuaries and then returns to freshwater.

An extensive survey of the coral reefs of the east coast of the Malaysian Peninsula has recently been completed under the supervision of an American, Dr. J. P. Green, a marine invertebrate physiologist who worked in Malaysia for six years. The survey was funded by the World Wildlife Fund (WWF), a body of the International Union for the Conservation of Nature, Geneva. Three specimens of each of over 200 species of coral were collected; sets of the specimens are now in the University of Malaya and the University of Agriculture Malaysia.

Additional threats to the coastal ecosystems come from some of the Malaysian fishing practices. A great deal of money has been made available for fisheries research but the funding of basic marine research and fisheries management has been meager. There is no supervision of net sizes nor of fishing areas. In 1960 the extensive use of trawlers was begun—a marked change in fishing practices and the nature of the catch. There are now too many trawlers fishing in too shallow waters, presenting a real threat to the coastal ecology.

UNIVERSITY OF SINGAPORE

My host at the University of Singapore was Professor R. E. Sharma, head of the Department of Zoology. Most of the marine orientation is in this department and the physics departments. Sharma is interested in marine biology in general, coral reef ecology, and noxious organisms. Conservation of wildlife is a special concern of Professor Sharma, and he is active in the Singapore Institute of Biology, Singapore National Academy of Science, and the Singapore branch of the Malayan Nature Society. The Malayan Nature Society publishes the *Malayan Nature Journal* and a supplement to it, the *Malayan Naturalist*. Both publications are primarily concerned with natural history, the conservation of animals and plants, and preservation of the environment.

Dr. D. H. Murphy is a general ecologist and entomologist who has become interested in the ecology of mangrove swamps. The insect populations of the mangroves are practically undescribed and offer rich material for collection and description. He is also interested in the bacterial flora of the mangrove habitats. He used simple plate isolation of the microfauna, most of which are amoebids, but many "weird" organisms have been identified from the mangroves. Half of the organisms are chemolithotropic (non-phototropic); much of this

microfauna is exploited for food by mud lobsters. Murphy is also working on pathogen transfer—many dangerous diseases are harbored in the swamps. I learned something about mud-skippers while I was visiting Malaya University. There are five species of these fish that can survive out of water and live in burrows in the mangroves, where there is very little oxygen. I was not surprised to learn that an Englishman, Dr. Stephen Lews, had proposed research on their oxygen metabolism. I was surprised, however, when my entomologist friend told me that these fish are bitten by mosquitoes. I neglected to ask if they have evolved scratching fins.

Dr. T. J. Lam is a fish physiologist, particularly interested in fish endocrinology. He has developed closed circulation seawater systems and is working on acceleration of gonad development in the rabbit fish, an important cultured species. He is feeding the fish thyroxine in an attempt to stimulate hormonal development. These fish, *Siganus javus* and *Siganus caneliculatus*, are the Chinese New Year's fish. They typically breed during that season and are traditionally eaten then, to bring good luck—to the Chinese, not especially the fish.

The Java *medaka* is a mangrove fish that is an ideal animal for embryological and reproductive studies, because of their rapid reproduction and ease of cultivation. It is easily reared, feeding on brine shrimp or commercially prepared fish food. The fish has a 24-hour reproduction cycle—it lays a batch of eggs every 24 hours for 10 days; after a nine-day resting period it starts again. The value of the salinity is not critical except that it needs some salt and some fresh water—the conditions of brackish water of highly variable salinity found in mangrove swamps.

Sarotherodon mossambicus (formerly *Talapia mossambicus*) is a potentially important species for cultivation. It is a mouth breeder and Lam is studying the endocrine control of its reproductive behavior and larval development. Although the female can be forced to expectorate the young and they can survive outside, their development is much retarded. Lam is using hormonal treatment, using thyroxine (which is responsible for metamorphosis of amphibians) to promote growth and development outside the mother's mouth. He is also studying the physiology of tetra fish, which are popular aquarium fish but are difficult to breed. In addition, he is investigating the commercial and hatchery reproduction of freshwater turtles, *Cheirodon innesi*, and environmental factors favorable for their breeding.

Dr. Leo Tan is using the Java *medaka* to investigate the effects of cadmium in the environment on the fish from the eggs on through larval and more advanced stages. There are readily observable acute effects of large doses of cadmium, but he is more interested in long-term low-level effects. He plans to go on to studies of zinc, mercury, and lead. He has an atomic absorption spectrometer for the determination of metal concentrations.

In the Faculty of Science there are departments of physics, chemistry, botany, and zoology, each with a head. Dr. Yean Joo Chong (Chong is the family name) is associate professor of physics. He has been attempting to use Landsat satellite imagery to map pollution, bathymetry, currents, and other oceanographic variables of the waters around Singapore. Principal difficulties are the frequent cloud cover over the area and the problem of getting adequate ground truth data. Under good conditions bathymetry is limited to depths of up to 2 meters. Much more ground truth than is available is needed to chart greater depths. He is analyzing computer-compatible tapes from the U.S. Geological Survey, using bands 4 (5000-6000 Å) and 5 (6000-7000 Å). Although joint surveys of the Straits of Malacca, one of the busiest waterways in the world, are carried out by Singapore, Malaysia, Indonesia, and Japan, their main purpose is safe ship traffic and dredging, and the charts are considered confidential. Chong uses university computers for his work. Although Chong is environmentally minded, most of the research in the physics department is generally laboratory-oriented orthodox physics, with researches in atomic spectroscopy, solid state physics, and solid state modeling. The department has a small neutron generator.

INDONESIA

Of any modern country, Indonesia may well be the most marine influenced. The archipelago consists of some 13,660 islands that extend 5,100 kilometers along the equator. I have been unable to get an estimate of the amount of coastline, but it is enormous; two-thirds of the national territory is covered by water. The population of over 130 million is unevenly distributed throughout the country, with 67% living on the islands of

Java, Bali, and Nadura. Although the government is attempting to push marine biology and oceanographic fisheries research, the resources are drastically limited. So far as I could determine, there are only two Indonesians with Ph.D. degrees in marine sciences. Both are at the National Institute of Oceanology in Jakarta. Dr. Aprilaui Soegiarto has his degree from the University of Hawaii; as director of the institute and more recently chairman of WESTPAC (the Intergovernmental Oceanographic Commission Working Group for the Western Pacific), his energies are almost wholly directed toward administration, leaving little time for research. However, he is attempting to build up a viable research institute with good scientific objectives, reasonable research facilities, and a competent staff of scientists and technicians.

LEMBAGA OSEANOLOGI NASIONAL–National Institute of Oceanology, Jakarta, Indonesia

The National Institute of Oceanology is one of 10 national institutes under LIPI, the Indonesian Institute of Science, a non-departmentalized institute directly under the President of Indonesia. The other institutes within LIPI are the biological institute, institute of geology and mining, and the institutes of physics, chemistry, metallurgy, instrumentation, electronics, economics and social sciences, and cultural research. There is also a National Documentation Center that is to be developed as a data center.

Within the National Institute of Oceanography, there are centers for oceanographic, marine biological, and ecological research, and two research stations, one at Ambon, the other on Pari Island. Mr. Susatno Birowo is Assistant Director for Development, and Mr. A. G. Ilahude is Assistant Director for Research. The staff includes two with Ph.D. degrees, 25 with their M.Sc., 14 with their B.Sc., and 47 technicians. In addition, there are 50 in administration and 30 research vessel crew members. The institute buildings include about 1800 m^2 of working space in Jakarta, 650 m^2 on Pari Island, and 500 m^2 at Ambon. The institute operates three research vessels: *Samudera*, 194 tons, 36 m. long, 6.5 m. beam; *Tirta*, 28.5 tons, 14.4 m. long, 3.7 m. beam; and *Mutiara* IV, 7.5 tons, 10 m. long, 3 m. beam.

The Center for Oceanographic Research is made up of laboratories for physical oceanography, chemical oceanography, and marine geology. The laboratories are rather sparsely equipped with conventional oceanographic instruments. They have around 40 Nansen-type sampling bottles and 40 each protected and unprotected deep-sea reversing thermometers. Mechanical bathythermographs have been supplied by the U.S. Navy, and they have some Ekman current meters. They are equipped to do oxygen titrations, salinity determinations with a Watanabe-Keiki induction salinometer, and nutrient analyses with a Spectronics spectrophotometer. They now have a program of coastal current measurements to help estimate the distribution of heat introduced by electric power generators. In the period 1969-1979 the institute's personnel have occupied around 1000 oceanographic stations. Most stations were only to 500 meters with a few to 1500 meters; the ship's winch holds only 2000 meters of wire. The data from these stations are published as *Oceanographical Cruise Reports;* they include data on temperature, salinity, sigma-t, dissolved oxygen, phosphate, nitrate, silicate, pH, plankton volumes, chlorophyll values, etc.

The geological laboratory is concerned with geological and geodetic mapping, coastal geomorphology, rates of sedimentation, mineral analysis, sediment distribution, accretion and abrasion in coastal areas, and analyses of foraminiferal size and mineral constituents, carbonates, and clay minerals. They have a Petterson grab sampler and they can take gravity cores. There are 10 scientists and 15 technicians in the oceanography and marine geology laboratories.

The Center for Marine Biological Research incorporates zoology and botany laboratories and a reference collection. A good part of the activity of the center is devoted to an inventory of the marine biota of economic importance and biological studies of these biota. There is a special laboratory for the studies of corals; it is now engaged in building up a reference collection of corals. Most of the inventories are made by skin diving in depths up to 7 meters, but some results have been accomplished with underwater photography. The center is accumulating data, mostly on fishes and echinoderms, on weight versus length, gonad maturity, food habits and stomach contents, and the relationship of these variables to environmental conditions. Also within the zoological and botanical laboratories are sections concerned with crustaceans, molluscs, algae, and sea grasses. The

crustacean laboratory is participating in work on the culture of crabs at the Pari Island Research Station. All the sections are concerned with inventories of the resources and biological studies. Sampling of crabs for the inventory is carried out using otter trawls, although sometimes new species are purchased in the local markets. The mollusc group is working on the systematics of gastropods (snails, conchs, octopus, etc.) and pelecypods (oysters, clams, cockles, etc.), especially the green mussel *Mytilis viridis* and the cockle *Fragum unedo.* In an attempt to predict spawning and the seasonal effects of the east and west monsoons, they are following gonad development in the animals. The laboratory is equipped with a good microtome and microscopes.

The mariculture laboratory in the Center for Ecological Research and the laboratory for botany combine forces to form an algal and sea grass group, also concerned with inventories of these resources. The algal species *Euchema spinosum* and *Euchema edule* both have important export potential; the algal group is trying to learn proper culture techniques to pass on to the marine farmers.

Inventory and biological studies are also the concern of the biological laboratory for fishes, where studies of weight versus length, stomach contents, and relationship to the environment are carried out. The most important species studied are skipjack tuna, anchovies, various bottom fish, and a small tuna called *tongkol.* Of the many fish species in Indonesian waters, only 20 or 30 are commercially important.

Plankton studies include inventories of productivity in terms of settling volumes for phytoplankton and displacement volumes for zooplankton. There are also sorting and counting activities. Chlorophylls a, b, and c are determined and the carbon-14 fixation method is used to assess primary photosynthetic productivity; the determinations are in cooperation with BATAN (*Badan Tenaga Atom Nasional*=National Atomic Energy Agency). Pollution of coastal waters is being assessed from counts of pathogenic bacteria made by three staff members who have master's degrees in microbiology.

The National Institute of Oceanology issues the following publications:

Marine Research in Indonesia: a scientific journal dealing with marine sciences in general. Issued three times a year in English.

Oseanologi di Indonesia (ODI): a scientific journal dealing with the results of research in Indonesian waters. Issued three times a year, both in English and Indonesian.

Oceanographic Cruise Reports: a compilation of oceanographic data of recent cruises. Issued irregularly in English. No. 23 contained hydrological, plankton, and pigment observations in the Salawese and Maluku seas observed from R.V. *SAMUDERA* from August 22 to September 23, 1977.

Pewarta Oseana: a bimonthly newsletter in Indonesian.

Lonawarta: a special newsletter for the Ambon field station. Issued every three months in Indonesian.

Occasional Publications: special publications on important matters, in Indonesian. Examples are; *Atlas Oseanologi Indonesia; Bibliografi Beranotasi* (Annotated Bibliography); *Bahan Makanan Dari Laut* (Food from the Sea); and *Ikan Beracun dan Berbisa* (Poisonous and Toxic Fish).

OCEAN DEVELOPMENT COMPLEX

The National Institute of Oceanology is part of what is being called an Ocean Development Complex, a loose organization coordinated by Professor S. Sastrakusumah, Professor in the Faculty of Fisheries, Bogor Agricultural University, Bogor, West Java. Coordination and cooperation are to be achieved largely by the various member organizations being located in physical proximity. The Bogor Institute of Agriculture is working on the completion of a marine laboratory in the complex, and a Naval Oceanographic Laboratory under the Department of Defence is contemplated. Under the Research and Development Directorate of the Department of Agriculture,

there is a Marine Fisheries Research Institute with five laboratories. Of the latter, one is now located in the Ocean Development Center, but most of the work of these laboratories is in the field. The laboratory, located in Bogor, and the National Institute of Oceanology are concerned with the preparation of reports of field work and on experiments on the culturing of shrimp, sea turtles, and other commercially important species. They conduct on-the-spot surveys of various organisms, including marine algae, in Pamanukan. The algae are now gathered by local farmers from wild stands; the laboratory is seeking to develop methods for algal culture.

Other projects of the laboratory are oyster culture (*Crassostrea* sp.) in West Java, the culture of rabbit fish, and leatherback turtle (*Erethmochelis infricata*) culture. The turtles lay their eggs in the Thousand Islands of Jakarta Bay. The bay is now polluted, mainly with silt and other particulate matter, posing a threat to the turtle population. Attempts are also being made to get the shrimp *Paneans monodon* to spawn in captivity. Other projects include studies of fishing economics, fishing gear and techniques, and estimations of maximum sustainable catches. The laboratory operates four research vessels in Samarong Harbor, and they carry out regular surveys of temperature, salinity, dissolved oxygen, and plankton in Western Java.

The Indonesian Naval Hydrographic Service has the responsibility, in cooperation with the Department of Communication, for updating hydrographic and navigational charts. They also issue *Notices to Mariners* and publish tide and current tables. The navy will be one of the participating group in the Snellius II expedition.

THE *SNELLIUS* II EXPEDITION

A major objective of Indonesian oceanographic research is to understand the interdependence of the Indonesian seas and the Pacific and Indian oceans. Current priority areas are the Java Sea and its surrounding waters, the Eastern Archipelago waters, and the Malacca and Macassar straits.

An ambition of the National Institute of Oceanology is to carry out a "*Snellius* II" expedition. The first *Snellius* expedition was carried out on the Dutch ship of that name in 1929 and 1930 under the direction of P. M. van Riel. Physicochemical oceanography, submarine geology, and marine biology were investigated with particular emphasis on exchanges of water among the various basins of the region and between the basins and the Indian and Pacific Oceans. Excellent bathymetric charts of the region were products of the expedition. But the investigation is now 50 years in the past, and updating the observations would be economically and sociologically important to this island nation as a basis for sound policy decisions in matters of development, management, and conservation of the marine resources of the country.

Snellius II is being proposed as the Indonesian part of a multinational investigation of the oceanography of the deep eastern Indonesian waters. There are to be programs in physics and meteorology, chemistry, geology and geophysics, biology, and fisheries. Observations will be made during both west and east monsoons. The proposed stations for physics are shown in Figure 1, those for chemical observations in Figure 2, and those for biology and fisheries in Figure 3.

A programmatic workshop on the Snellius II expedition was held in Jakarta in December, 1978. Sixteen government agencies and institutions are involved in the project and a training program, with which UNESCO is helping, is underway; two trainees are now abroad.

During *Snellius* II there will be sea level observations from tide gauges and moored current meter observations in the passages around the Banda Sea to assess replenishment of waters in that sea. A major chemical effort is being called SNELGISEC, Snellius Geochemical Interocean Sections. Patterned somewhat after the GEOSECS (Geochemical Ocean Sections) program of the National Science Foundation, three or four detailed sections connecting the Indian and Pacific Oceans through Indonesian waters will be occupied. Observations planned include salinity, temperature, O_2, CO_2, pH, nutrients, trace metals, natural and artificially produced radioisotopes, and fossil hydrocarbons.

It is anticipated that the program will be carried out by 59 researchers and 63 technicians in addition to

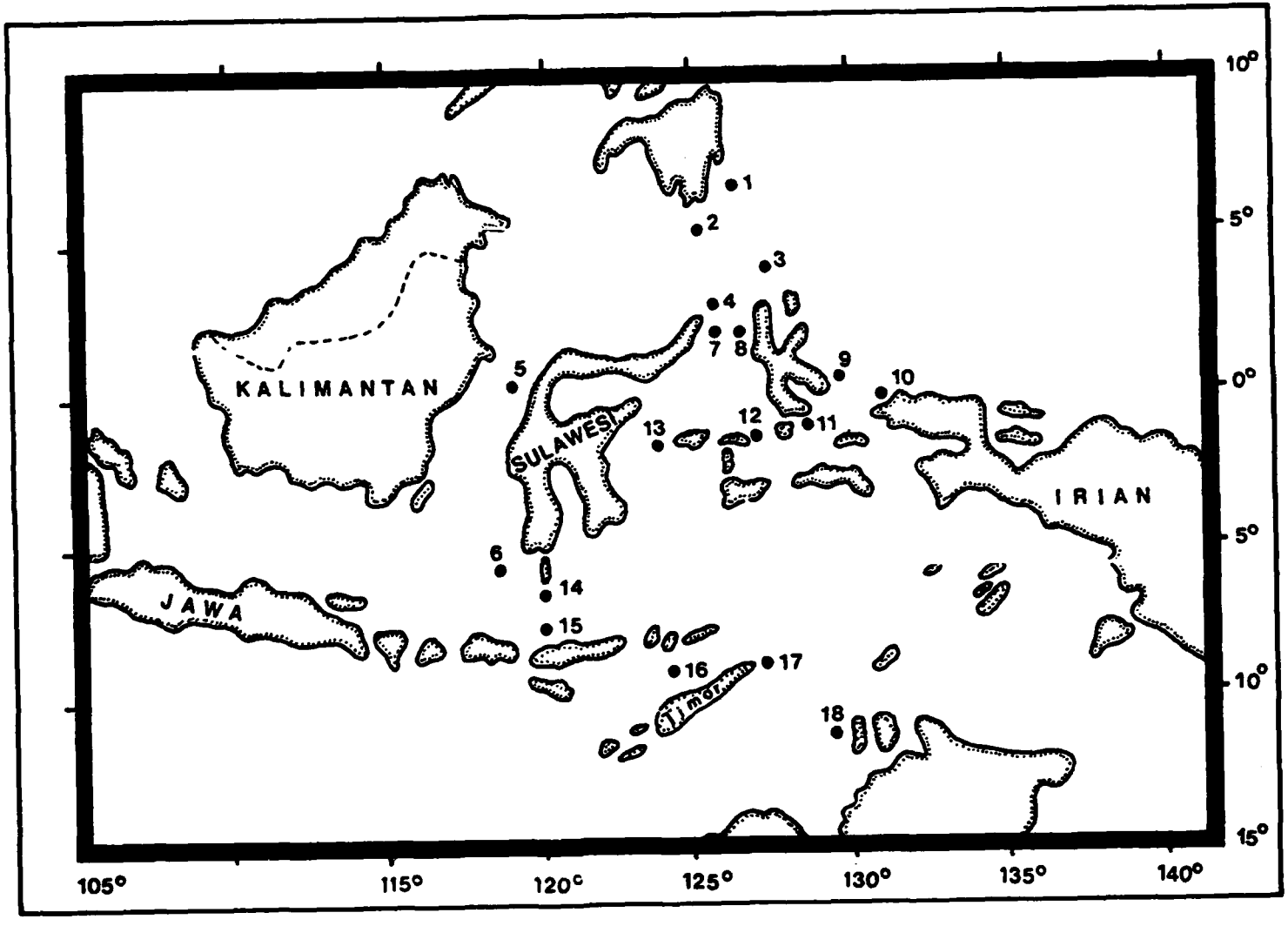


Figure 1. Proposed stations for physics in the Snellius Expedition II, Meteorological observations will be made along the cruise.

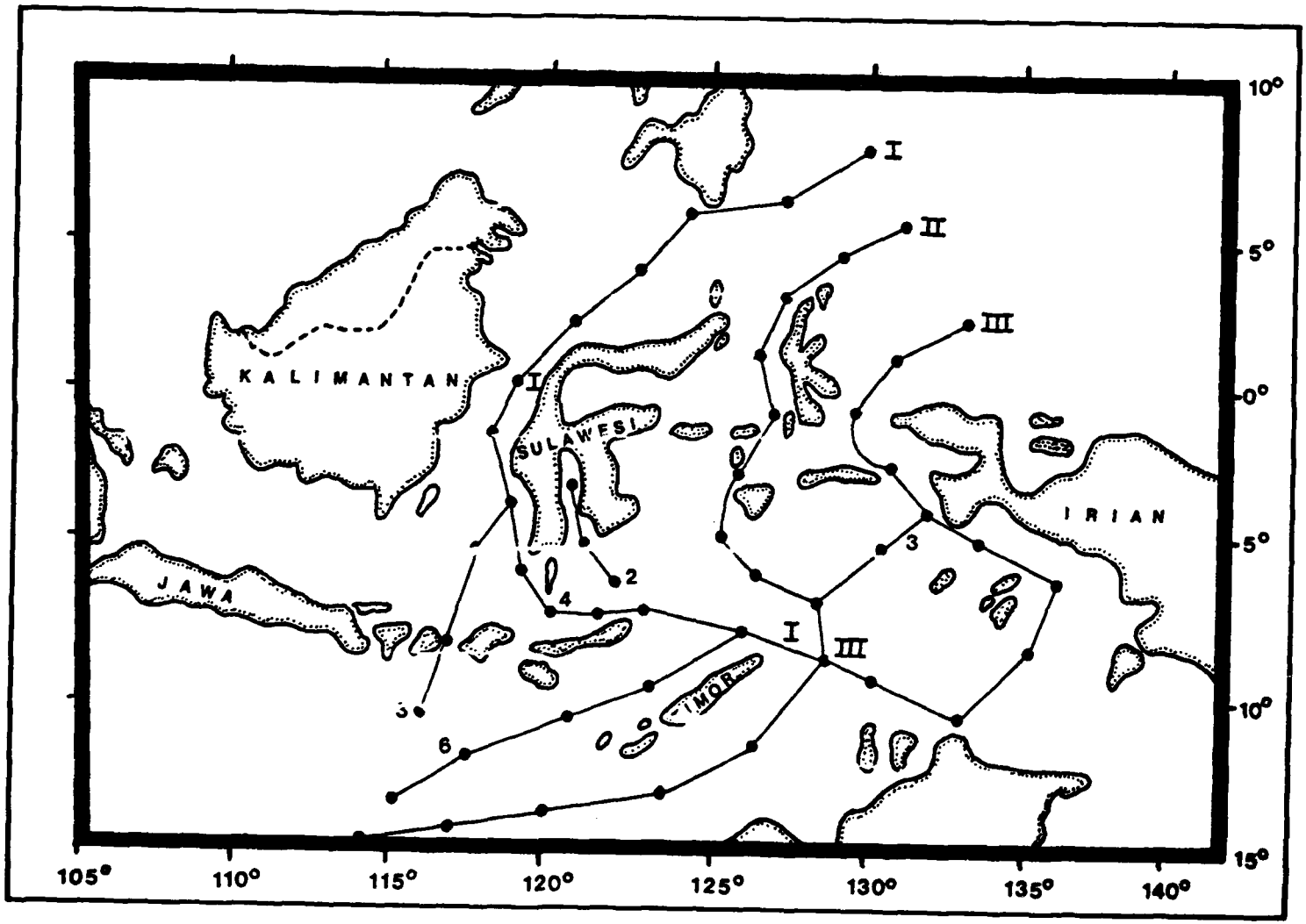


Figure 2. Proposed stations for chemical observation in the Snellius Expedition II.

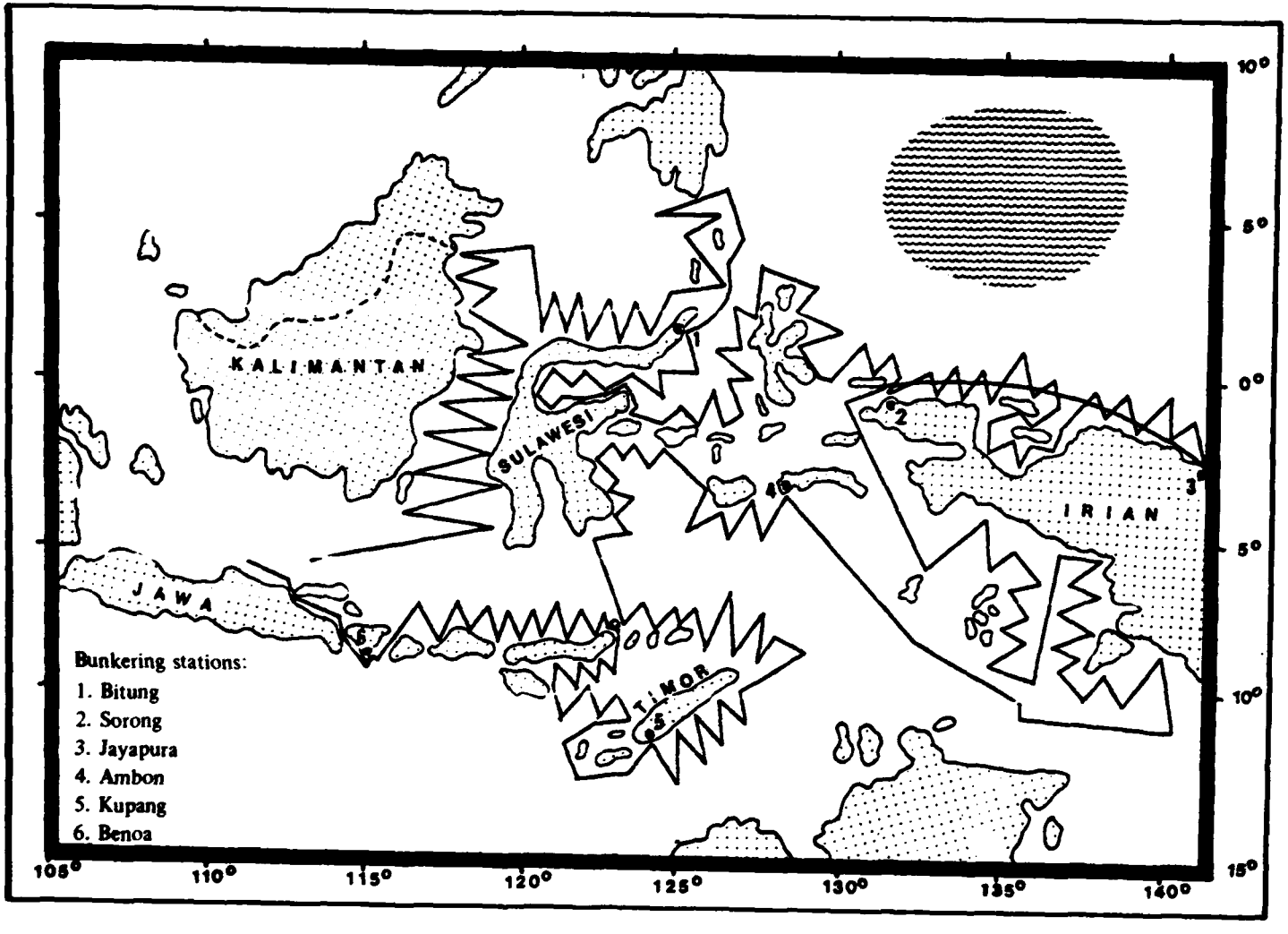


Figure 3. Proposed track for biology and fisheries in the Snellius Expedition II.

ship's crews. Indonesia has four research ships that could be used in the expedition: KRI. *Jalanidhi*, 750 tons, KRI. *Burujalasad*, 1800 tons, R.V. *Samudero*, 190 tons, and R.V. *Madidehaing*, 291 tons.

The Snellius II expedition will depend to some degree on the success of finding foreign funding; the Intergovernmental Oceanographic Commission and other U.S. agencies may be asked for support. Individuals from several nations have expressed interest in the program, including the Netherlands, United States, Japan, the Philippines, Malaysia, Australia, and New Zealand. Detailed lists of equipment, some now available in the Indonesian research fleet, some that will have to be procured, have been drawn up. A total budget of 1,218,000,000 rupees has been drawn up (U.S. $ $\simeq$ 620 rupees).

The expedition is planned for the 1980's to coincide with the 50th anniversary of the *Snellius* I expedition.

This appears to be a well-conceived plan, one which, if successfully executed, would make substantial contributions to scientific oceanography and to Indonesia's practical requirements for knowledge of their marine environment. It will stretch the capacity of the Indonesian oceanographers, marine geologists, biologists, and fishery experts. Its successful completion would be a significant credit to their oceanographic efforts.

MANILA, PHILIPPINES

The Marine Science Center of the University of the Philippines was described in an earlier issue of the Scientific Bulletin (Vol. 3, No. 3, pp 26-28). In addition to the research activities of the Marine Science Center, there is a graduate degree (M.S.) program in the Department of Meteorology and Oceanography; the degree is offered in either oceanography or meteorology. Professor Dominador C. Canlas has his M.S. in oceanography and holds a Ph.D. in cloud physics from New York University. Students with degrees in engineering, physics, or mathematics can enter the graduate program; a Ph.D. program in meteorology is being planned. The department was started in 1968 and the oceanography option was added in 1970. The department has graduate students from Taiwan, Thailand, Burma, Malaysia, etc., who study in the Philippines as part of the Colombo plan to support foreign students, a program funded mainly by Australia.

Research projects in the department may be supported by the Marine Science Center, the University of the Philippines' Office of Research Coordination, the National Science Development Board Research Program, the National Research Council, or by private funding agencies.

Much of the research in the department is related to cloud physics, climate, weather, tropical storms, and air-sea interaction. Canlas is also interested in practical applications such as "wind energy extraction" (windmills) and solar water heaters. However, he has a wide range of interests ranging from such megaquestions as long-term meteorological cycles and trends (is the earth cooling?) to the microphysics of the formation of raindrops from clouds. Some of the students are working on measurements of currents in channels between the islands, using simple but direct visual observations of drogues.

Canlas has been interested in the different effects of surface winds from the Kuroshio region on rainfall in various parts of the Philippines, and he presented a paper on this subject at the Fourth CSK (Cooperative Studies of the Kuroshio and Adjacent Regions) Symposium held in Tokyo in February, 1979. Clouds, precipitation, and the characteristics of typhoons are being studied.

The department suffers from the lack of a research vessel, but they are extracting temperature data from ship's reports for oceanographic studies and using various land-based observations, such as tides, temperatures, rainfall, and precipitation data for various oceanographic, cloud physics, and air-sea interaction studies. I was also shown a homemade "black box," insulated with crumpled newspaper, that records temperatures, rainfall, simultaneous cloud cover, and other meteorological data. The department's research budget appears to be limited, but they appear to be making the most of it.

Much of the marine science policy in the Philippines is promulgated by the National Commission for

FOUR INDONESIAN RESEARCH VESSELS

Name	Tonnage		Service Speed	Length	Beam	Draft	Cruising Range	Complement			
	Displ.	Gross	(Knots)	(m)	(m)	(m)	(Naut. Miles)	Officers & Crew	Scientists	Laboratories	Yr. Built
Kri *Jalanidhi*	197	433	7	46.3	8.0	3.4	5,000	47	21	5	1963
Kri *Burudjulasad*	1800	2150	15	82.	11.4	4.0	14,500	145 (total)		3	1966
R.V. *Samudera*	191	750	7	36	6.5	?	3,500	26	13	1	1952
R.V. *Madidihang*	133	292	9.5	41	8.2	3.8	?	15	30 others	1	1977

Notes: Kri *Jalanidhi*: Has balloon launching pad, Decca/TM 262 radar. Built in Sasebo, Japan. Owner-Operator: JANHIDROS (Naval Hydro-Oceanographic Service).

Kri *Burudjulasad*: 4 x 1500 H.P. engine. Twin screw. Helicopter pad, survey boat; landing boat (LCVP) Redifon 262 A loran receiver. Built in W. Germany. Complement listed as: Captain; 12 officers (12 cabins); 28 passengers in 1 cabin; patient quarters, 16 people in 2 cabins; 88 sailors, 24 in 12 cabins and 64 in 1 cabin. Owner-operator: JANHIDROS.

R.V. *Samudera*: Small Nansen and plankton winch; heavy trawl, dredge, grab winch; Kelvin-Hughes M26 echo sounder. Furuno radar. Built in Foxhal, Netherlands. Owner-operator: LON-LIPI (National Institute of Oceanography).

R.V. *Madidihang*: Fisheries training ship. Controllable pitch propeller; radar; RDF; fish finder; net recorder; loran; sonar, facsimile receiver; electromagnetic log; cargo, trawl and hydrographic winches, fish holds and freezer. Owner: AUP, Akademi Usaha Perikanan–Academy of Fisheries, Dept. of Agriculture.

Marine Sciences (NCMS). Formerly under the National Science Development Board, it is now under the Philippine National Commission for UNESCO in the Ministry of Foreign Affairs. The commission is made up of representatives of governmental and non-governmental agencies and academic institutions. These include the National Research Council, a non-governmental agency concerned with basic science; its counterpart, the National Science Development Board (NSDB), concerned with applied sciences; the Colleges of Fisheries and of Arts and Science, and the Marine Science Center, of the University of the Philippines; Mindanao State University; the Bureau of Coast and Geodetic Survey (Ministry of National Defense); the Bureau of Fisheries; Bureau of Mines; the National Museum; the Philippine Navy; and the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA, essentially a weather bureau).

Marine science programs under NCMS also include fresh and brackish water systems. Biological programs are the main concern of the Bureau of Fisheries; the Bureau of Coast and Geodetic Survey has the responsibility for physical oceanography; pollution and chemical programs are under the Navy, the Bureau of Fisheries, and the Marine Science Center; meteorology is under PAGASA, and geology and geophysics are under the bureaus of Mines and Coast and Geodetic Survey. Thus, most activities in physical oceanography are at the university and the Coast and Geodetic Survey.

The director of the Coast and Geodetic Survey is Commodore Antonio P. Ventura; his headquarters are at 421 Barraca Street, San Nicolas, Manila. The bureau has a scientific staff of about eight, including hydrographers, oceanographers, and geophysicists. The primary concerns of the bureau are in the physical oceanography of Philippine waters, bathymetry, tidal and current observations, temperature and salinity observations to help estimate water mass exchanges within the archipelago, and wave studies. The bureau participates in the warning network of the tsunami warning center located in the U.N. Center, Honolulu. As part of this program they operate a wave observation station on the east coast of the island of Luzon. A second station is planned for Davao on Mindanao, where there is an existing tide station, and a third station for north of the islands has been requested. However, tsunami warning stations must have rapid communications and this presents some difficulties in establishing new stations.

The Coast and Geodetic Survey operates four survey vessels, the R.P.S. *ATYIMBA* (built in 1969), the R.P.S. *ARINYA* (1962), the *ARLUNYA* (1964) and the R.P.S. *PATHFINDER* (1908!). The *ATYIMBA* participated in the FGGE [First GARP (Global Atmospheric Research Program) Global Experiment]. Special instrumentation for the program, including a satellite navigator, was furnished by the World Meteorological Service.

The Coast and Geodetic Survey is surveying the exchanges of water and currents in various passages and straits in the Philippine waters, making direct current measurements at anchor stations. Different areas have differing priorities, depending on their specification as sea lanes. In 1979 the primary interest is the Sulu Sea and exchanges through Surigao, Mindoro, Balabac, Sibutu and Basilan straits.

The bureau is responsible for producing and updating bathymetric charts. The available bathymetry for much of the country is adequate for navigation, but this is not the case for large parts of the western and southern coasts.

An operational organization, the Bureau of Coast and Geodetic Survey appears to be producing good, reliable data that could form the basis for oceanographic studies. Their mission is, of course, to produce oceanographic and bathymetric products for the public and the military.

NATURAL RESOURCES MANAGEMENT CENTER (NRMC)

The focus of NRMC is on the use of remote sensing, computerized imagery interpretation and mapping, computer modeling, and data bank techniques. It is a resource information and research agency attached to the Ministry of Natural Resources (MNR). The center was created on 25 October, 1976, by Presidential decree;

shortly thereafter it acquired the G.E. Image 100 Multispectral Image Analyzer, the center's most valuable material asset and the first of its kind in Southeast Asia.

Under the executive directorship of Dr. Celso R. Roque, the center is organized into divisions for remote sensing, technical services, information systems management, strategic research, external services and public information, and administrative and finance services. The Strategic Research, Information Systems Management, and Remote Sensing Divisions are the main centers for research.

The Information Systems Management Division is responsible for setting up a digital system for collecting natural resource data for all the Ministry of Natural Resources (Bureaus of Fishery and Aquaculture Research, Forestry Development, Lands, and Mines) and some attached agencies including the Fisheries Industry Development Council and the Forest Research Institute.

The Strategic Research Division is responsible for studying resources, making projections, and developing policy on resources management, including marine resources, mangrove swamps, etc.

The Remote Sensing Division, under the direction of Mr. Ricardo T. Bifia, is attempting to fill the gap between ground truth data and remotely sensed data, with emphasis on Landsat data.

A major program of the Remote Sensing Division, a joint program with the National Science Development Board, is to develop the use of Landsat data for coastal resource inventories and environmental monitoring. Within the program there are several projects. These include attempting to map different geologic substrate types in shallow water, such as sand flats, coral reefs etc., and the mapping of major biological communities such as sea grass regions and the major different coral communities. The site for the multidisciplinary study is Lingayan Gulf, northwest Luzon, in which there will be a study of the circulation by following sediment plumes being introduced to the gulf from rivers. A closely related project is trying to approximate the core of mine tailings introduced to the gulf from the rivers. There are copper, gold, and other mines in the Baguio area, and although there are attempts to impound the mine tailings, the ponds frequently overflow and dump tailings into the rivers. The correlation of brightness values with tailing concentrations is being investigated.

Another part of the Lingayan Gulf program is the investigation of changes in the shoreline topography by comparing old aerial photography and maps with recent satellite data, with the objective of evaluating the changes in terms of areas susceptible to erosion by wave action. Attempts will also be made to correlate water color as sensed by Landsat with chlorophyll, primary photosynthetic productivity, and ultimately with fish production. Certain specific traditional fishing grounds appear to have a specific signature in the imagery, and in some cases schools of fish have been correlated with a specific type of turbidity in the imagery.

The Lingayan Gulf studies, initiated in January 1979, are in support of the Coastal Zone Management Program of the National Environmental Protection Council, now under the Ministry of Human Settlements. The general mission is to find out how much information in support of the program can be acquired by satellite. In the Lingayan Gulf studies the task is to acquire as much ground truth data as possible at times of Landsat passes. For open water movements, the center plans to coordinate with the Philippine Navy and the College of Fisheries of the University of the Philippines, using their research vessel *Albacore*. River gauging will be made by PAGASA and sent to the computer by radio. Geological ground truth will be furnished by a field team of six geologists.

Another program of the center calls for the continuous monitoring of mangrove swamps. An inventory based on 1972-1976 data has been completed. It has been possible to identify logged-over areas and mangrove swamps critical to the culture of milkfish. This is an ongoing program, as are programs for forest inventory, land-use mapping on a regional basis, and geological mapping.

Under the Natural Resource Management Center, there is a Marine Parks Committee established to study the feasibility of setting up marine parks and reserves.

The Remote Sensing Division includes five service units: the geology group, the land-use group, the oceanography and marine resources group, the forestry group, and an environmental monitoring group.

Landsat data are acquired on computer-compatible tape (CCT), and the center has a standing order with NASA for every passage of a satellite over the Philippines, but of course much of the time, there is cloud cover over the area. Considerable delays (many local) are experienced in acquiring the data, but after processing, maps and reports based on the specific programs and projects are issued. Special task forces may be set up to comply with special requests from the ministry.

The Remote Sensing Division is now trying to set up its own standardized information system, patterned somewhat on the EROS data center, to service the Philippines and to serve as a clearinghouse for remotely sensed data, excluding aerial photographs. The division does use aerial photographs to establish correlations, but military clearance is needed to get aerial photographs. Preparation of base maps has been the responsibility of the Bureau of Coast and Geodetic Survey; at least part of this responsibility is being taken over by the Photogrammetry, Cartography, and Remote Sensing Agency of the Philippines.

The Natural Resources Management Center has begun two serial publications: (1) *LIKAS-YAMAN, Journal of the Natural Resources Management Forum.* Four of the forums were held from October 1978 to January 1979 and covered the following topics: "Global resource problems and national strategies," "Forest management problems, issues and strategies in the Philippines," "Mangrove forests: problems and management strategies," and "Problems, issues and strategies in fisheries and aquatic resources management in the Philippines." The center also issues *NRMC Research Monographs.* Six were issued in 1978: "A study on computer analysis of land use classification of Metro Manila," "Mangrove inventory of the Philippines using Landsat multispectral data and the Image 100 system," "Coral reef mapping using Landsat data; follow-up studies," "Landsat–assisted forest inventory of the Philippine Islands," "Detection and monitoring of water hyacinth (*Eichhornia crassipes*) infestation in Laguna de Bay through multispectral digital analysis of Landsat imageries," and "Processing and analysis of Landsat data covering the Baguio mineral district, northwest Luzon, Philippines." "The exportation of Philippine mahogany hardwood" was the first monograph issued in 1979. The center also issues a news magazine "Printout."

NRMC gives the impression of a busy group of capable scientists and technicians using remotely sensed data in the study of a number of environmental and resource problems of significance to the economy and general well-being of this developing nation. I was particularly impressed by the enthusiasm and evident capability of my host, Mr. Biña, the products the center has issued, and the plans they have for the future use of remotely sensed data.

MARINE SCIENCES IN HONG KONG

Francis A. Richards

The Scientific Directory of Hong Kong, fourth edition, 1978, was compiled by the Committee for Scientific Co-ordination, Hong Kong. Under fisheries and oceanography it lists 13 officers of the Agriculture and Fisheries Department, most of whom are concerned more with fisheries than with oceanography. Seven are listed as research, rather than fisheries, officers, and their main interests are in environmental resources, water pollution, aquaculture, and ecology. Their resources include a research vessel equipped for fishery research and hydrography. They also have sediment grabs, plankton nets, an automatic analyzer for nutrient determinations, and a reference and research fish collection.

There are two major universities in the colony, the University of Hong Kong and the Chinese University of Hong Kong. The former is older, larger, located on the island of Hong Kong, and classes are conducted in English. The Chinese university is the amalgamation of three predecessor institutions of higher learning and part of this heritage is that classes may be conducted in Mandarin, Cantonese, or English. It is north of Kowloon in the New Territories (which are leased until 1999 from the Peoples Republic of China).

A unit of the Chinese University is the Marine Science Laboratory, of which Dr. L. B. Thrower is the director and Dr. W. Y. Tseng is the associate director. Although the aims of the laboratory are interdisciplinary, the main efforts now are in mariculture. In Hong Kong, mariculture is a family-style operation. Much of it is carried out in shallow ponds that are created in mangrove swamps separated from the sea by a gate. The ponds, which are around 1 meter deep, are fertilized by the detritus from the mangrove trees (of the genus *Candelia*) and *Phragmites* sp. grasses. The ponds, which are on the order of 10 hectares, are about 40% water-covered. The mangrove leaves and *Phragmites* debris decompose rapidly, losing about 80% of their dry weight in four months. The ponds are therefore rich sources of organic matter. The industry depends on the purchase of fingerlings, and a main project of the Marine Science Laboratory is working out methods, essentially on a pilot plant scale, for producing such fingerlings. The laboratory is not complete, but there is a small indoor culture room, associated laboratories, and a battery of outdoor tanks with provisions for water and air supplies. Dr. Tseng is doing most of the mariculture work (Dr. Thrower is a plant physiologist), and he has induced breeding of the sea bream *Mylo marcephalus*, which he has reared to the fingerling stage. Shrimp culture in Hong Kong is in an infant stage and is carried out in an extensive, versus intensive, mode. Tseng is now working on the culture of shrimp (*Metapenaeus monoceros* Fabricus) larvae, which he has grown to the P_{46} (postlarvae after 46 days) stage.

Although the laboratory is practically a one-man show, Tseng is capable, enthusiastic, and should be successful in his work. He has his doctor's degree from the University of Tokyo, his B.S. from Taiwan National University, M.S. from the University of Guam, certificates in marine biology from Tokyo and Copenhagen, and a certificate in biological oceanography from the University of Hawaii. He brings a rich and varied background to his work.

At the University of Hong Kong, marine science research is largely in the Zoology Department, where Dr. Brian Morton is particularly interested in the shoreline ecology of Hong Kong and in pollution problems. Morton was also active in the pollution monitoring activities of the CSK (Cooperative Studies of the Kuroshio and Adjacent Regions) program. He is a man of widespread interests and although basically a zoologist (his principal specialty seems to be molluscs), he has worked on the hydrology of the coastal waters of Hong Kong, heavy metal and oil pollution problems, the conservation of Hong Kong's shoreline, and the fouling and corrosion of painted metals.

Although oyster culture is important in Hong Kong, it is carried out in polluted waters and frequently the means for purifying the animals before they are marketed are less than adequate. Morton has demonstrated their contamination by faecal bacteria, infestation of the oyster (*Crassostrea gigos*) by a parasitic worm, *Echinocephalus sineusis*, and by very large quantities of chromium, introduced into their habitat by tanneries.

In the field of population dynamics, Morton has carried out research on the colonization of Plover Cove Reservoir by *Corbicula fluminea* and *Limnoperna fortunei*, both bivalue molluscs that are real or potential pests in domestic water systems. The creation of the Plover Cove Reservoir has provided an opportunity to observe ecological and other changes as an environment is converted from a marine to a freshwater system. The reservoir was created by damming off the Plover Cove arm of Tolo harbor. The dams were completed to above sea level in 1967 when the pumping out of the salt water was begun. In 1968 the reservoir reached a capacity of 39,000 million gallons. Later (1973), the raising of the dams by 12 feet was completed, increasing the capacity to 51 x 10^9 gallons. These changes have resulted in an acceptably low salt content; the succession of dominant planktonic algae from blue greens to greens to diatoms; the intentional and accidental introduction of a variety of fish species; and invasion by three gastropods and three bivalves, *Corbicula fluminea, Limnoperna fortunei,* and *Pletholophus discoides.* The *Limnoperna* (the only freshwater mytilid) has succeeded in colonizing most of the reservoir, including the underground network of tunnels and pipelines; the fouling potential of these species is high and methods are being sought for the control of the animals.

With its enormous population growth, more and more of Hong Kong's shoreline is being lost to development of various kinds, and a major interest of Morton is in the ecology, conservation, and appreciation of what natural shoreline is left. He has published descriptions of the coastal habitats and has undertaken the project of educating the school children of Hong Kong about the shoreline and its populations. As aids in his project, he has prepared a nicely illustrated series of booklets called *Shore Watch.* There is first a small identification guide and the *Seashore Code,* which gives the rules for observing plants and animals without damage to them. There is a booklet on *Students' Projects,* which suggests a variety of ecological studies that can be carried out with little equipment and yet expose young people to scientific methods and to an appreciation of ecology. It is a project that might well be taken up by other marine communities; it is sponsored by the Lions International, Caltex Oil H. K., Ltd., Hong Kong University, the Conservancy Association, and the Hong Kong Education Department.

Hong Kong is faced with enormous ecological problems–including the problems of human ecology. The research efforts at Hong Kong University in ecology, and those at the Chinese University of Hong Kong in mariculture, appear to complement each other and to constitute a significant attempt to improve the quality of life in this crowded colony.

NEW ZEALAND MARINE STATIONS

Francis A. Richards

The University of Auckland, Victoria University of Wellington, the University of Canterbury, and the University of Otago all operate marine laboratories. All welcome visiting investigators with the general exception that there is little or no space available when classes are being held, usually during university vacations. The stations are:

University of Auckland Marine Research Laboratory
Leigh. About 80 km north of Auckland on the east coast. Director is Dr. W. J. Ballantine.

Victoria University of Wellington Marine Laboratory
396-402 The Esplanade, Island Bay, Wellington. About 7 km from the center of Wellington, it faces the open sea at the southern end of Cook Strait. Bookings should be made with the Professor of Zoology, Victoria University.

University of Canterbury Edward Percival Marine Laboratory
P.O. Box 11, Kaikoura. The laboratory is on the Kaikoura Peninsula about 200 km from Christchurch. Resident lecturer in charge is Mr. I. Mannering.

The University of Otago Portobello Marine Laboratory
P.O. Box 8, Portobello. The laboratory is on the southern side of Otago Harbour, 20 km from Dunedin and 2 km from Portobello village.

The abbreviations A, V, C, and O will be used to designate the laboratories in the following.

FACILITIES FOR VISITING WORKERS

A: Open all year. Space for seven researchers. Bunkrooms, kitchen, etc.
V: Open all year. No quarters, but housing, etc., available in Wellington.
C: Visitors welcome except in May and August. Accommodations for sleeping and cooking for 24.
O: Open all year. Cottage with six beds available for short-term visits. Other facilities available in village and Dunedin.

LABORATORIES

All have 230/240v AC, various aquaria and tanks, and general biological equipment. Sophisticated equipment generally available at the parent university.

BOATS

A: Three 3-m aluminum dinghies and 6-m high-speed deep V runabout *Vidalia.* Seagoing fishing boats (9-12 m) can be hired locally.
V: 13.1-m *Tirohia,* built in 1966; four-berth accommodation, 95-hp main engine; trawl winch, echo sounder; autopilot; underway temperature recorder and 200-m temperature probe. Dinghy and

6-person inflatable raft; 3-m aluminum dinghy with 5-hp outboard; 4-m fiberglass workboat with 20-hp outboard and trailer.

C: 4-m clinker dinghy on trailer; 2.5-m aluminum dinghy; local fishing boats can be hired.

O: 14-m ocean-going trawler *Munida* with 112-hp Kelvin engine, 7.5 k.v.a., echo sounder radar, RDF, autopilot, six bunks. Hydrographic and trawl winches with 1300 m of 8- or 4-mm wire. Two 5-m and one 3-m boats.

LIBRARIES

All stations have small libraries of reference works and biological reprints. Generally excellent libraries are at the parent universities.

COURSES

A: Algal physiology, plankton, shore ecology, etc.

C: Undergraduate courses on autecology and community ecology in May and August.

O: Students enrolled for M.Sc. and Ph.D. and undergraduates working on marine projects use the laboratory. Various undergraduate field trips are held.

SPECIAL FEATURES

A: MSE centrifuge (6,000 r.p.m.) Uvispec spectrophotometer, Leitz inverted microscope and standard microscopes. Warburg and oxygen electrodes, pH meter, conductivity cell. Geophysical laboratory with hydrophones, recorders, etc. Long-wheelbase Land Rover.

V: Small flagellate bank, Hird-Brown photoelectric counter and digital printout system for monitoring rhythmic behavior. Grant 6-point autotemperature plotter. General Oceanics film recording current meter. Biomarine dissolved oxygen analyzer with 50 m of cable. Autolab inductive salinometer. There is an electron microscope available in the Zoology Department.

C: Filtered and sterilized seawater is available in quantity.

O: U.v.-visible spectrophotometer, spectrometer, photoelectric titrator, bomb calorimeter, inductive salinometer, underwater camera; seawater filtration and sterilization unit. There is an aquarium for public display and research. The university has an electron microscope unit and a computer center on the campus in Dunedin.

HABITATS

A: Within 8 km almost every kind of shore from mangrove swamps and quiet harbors to exposed rocky shores and open beaches. Fauna and flora are transitional warm temperature species but a number of subtropical species are included. The clarity and temperature of the water make the area excellent for diving, and an air compressor is available in Leigh village.

V: Exposed shores outside the laboratory and a variety of other shores nearby. Enclosed sheltered waters within Wellington Harbour and extensively in Marlborough and Pauatahanui areas. Deep-water canyon in Cook Strait within four hour's sailing time. There is a variety of other sub-littoral habitats within the working area of *Tirohia*. There are six experimental rafts and a fully serviced climatological station complete with Lambrecht Anemograph in Elie Bay, Marlborough Sound.

O: Rich sheltered rock, sand, and mud shores near laboratory. Continuously wave-exposed shores within a few kilometers. Continental shelf and slope accessible in a day's run of *Munida*.

CLIMATE

A: Mild, relatively high sunshine (2000+ hors per year) and rainfall (125 cm). Offshore sea surface temperature range is 12-22°C.

V: Temperate and changeable with high winds. Little frost, around 2,000 hours sunshine per year, rainfall 118 cm. Sea surface temperature in Cook Strait 11-16°C; in Wellington Harbour 9-17°C; mean spring tides 1.5m.

C: Mild, occasional frosts on the coast. Annual rainfall 75 cm; sea surface temperature 7-18°C.

O: Cold, temperate, and unpredictable. Frosts in June and July. Rainfall 64 cm. Harbor surface temperatures 5-19°C. Warm, waterproof clothing may be needed any time of the year.

SPECIAL NOTES

The Leigh Laboratory is in the central part of the Cape Rodney to Okakari Point Marine Reserve. The marine reserve is the first and only one in New Zealand. It was established on November 7, 1975, after a long and difficult series of legal events that took place largely in response to pushing by the University of Auckland and the director of the Leigh laboratory. There was no New Zealand law for establishing marine parks, and although such a park was suggested as early as 1964, it was not until 1966 that the government was approached by the Minister of Marine for enabling legislation. However, the Marine Reserves Act was finally passed in 1971 and in May of that year the University of Auckland posted notices of intention applying for an Order in Council to declare a marine reserve.

The marine reserve extends from mean high water mark "40 chains from the nearest part of the high water mark between Cape Rodney and Okakari Point." The reserve contains 1357 acres (549.1 hectare) and a rich variety of habitats, flora, and fauna. D. P. Gordon and W. J. Ballantine have published "*Cape Rodney to Okakari Point Marine Reserve. Review of Knowledge and Bibliography to* December, 1976," as a supplement to TANE, Vol. 2, 1976, issued by the University of Auckland. The review covers the history of the area, coastal features and habitats, wildlife, zooplankton, marine flora, climate, hydrology, terrestrial vegetation, land use and public access, the Leigh laboratory, conclusions and future prospects, and a bibliography of some 250 entries. The faunal check list has 942 species from the Marine Reserve, 1259 from the Leigh area. Eleven new animal and one new algal species from the Marine Reserve have been described since 1965.

The Marine Reserve offers an excellent site for ecological and environmental monitoring. Because it is an ideal place for diving, populations can be mapped, changes followed, and hopefully cause-and-effect relationships can be established. Detailed observations can be made without disturbances from commercial activities. In some cases, divers have grown so familiar with parts of the reserve that they can recognize individual fish within their specific territorial waters. The observations are aimed at such problems as assessing the normal size of populations, whether the populations are stable, and how the food web is constructed.

The ecology of seaweed forests is being studied because of the importance of seaweeds as nursery grounds and shelter for small fish, as food for sea urchins and for some fish, and as a source of detritus for particle feeders.

Researchers at the laboratory have been developing new tehniques for underwater mapping. Aerial photography is used to give the gross features of an area, and divers are using survey techniques to map the geology of the bottom and the distribution of the flora and fauna. Comparisons of the marine reserve with exploited regions are being made to determine the effects of fishing on the crayfish stocks, the relationships between the numbers of crayfish and of sea urchins, whether or not the sea urchins are responsible for the destruction of the kelp forests, and how quickly fish repopulate depleted areas.

The Leigh laboratory has recently been expanded with new and very attractive laboratories, library, tank rooms, accessory rooms for SCUBA divers and their equipment, and new living spaces. It 's a beautiful site and a good environment for biological, particularly environmental marine biological, research.

The Island Bay Marine Laboratory of the Victoria University of Wellington is across the road from the exposed shore of Cook Strait which, when the wind is in the proper quarter, has an unobstructed fetch all the way to Antarctica. The salt water intake for the aquaria is in the surf zone, and presents a problem because it

New Zealand Marine Stations

comes into the laboratory supersaturated with air. In the aquaria, the air comes out of solution and forms bubbles, frequently and sometimes fatally on the gills of the laboratory animals. Several schemes for degassing the water have been tried, but none has been wholly successful. In addition to this direct supply system, the laboratory has two recirculating systems which are highly versatile and can supply fresh or salt water at different temperatures to tanks of varying size. The system was designed in part to carry out replicate experiments on the growth of young freshwater eels, but a wide variety of experiments can be conducted.

Some of the research projects at the laboratory are on the life history of a local swimming crab, *Ovalipes clathrus*. A special tank has been built for studies of a crab that buries itself in the sand. The sand is kept clean by forcing water up through it and out a central drain. The circulation rate for the tank, which is about 10 feet in diameter, is about 1000 gallons per hour.

One graduate student is working on the feeding habits of flounder and sole, investigating such things as gut contents, the sensory organs of the fish, especially the taste buds, the histology of the brain, behavior patterns, rhythms, and manner of approaching food.

The proximity of this laboratory and its good facilities make the Island Bay Laboratory an inviting place where a visitor should be able to do good research.

DSIR: NEW ZEALAND OCEANOGRAPHIC INSTITUTE, GEOPHYSICS DIVISION, AND ANTARCTIC DIVISION

Francis A. Richards

The New Zealand Department of Scientific and Industrial Research (DSIR) has as its first responsibility initiation, planning, and implementation of scientific research calculated to promote the national interest. Its scope ranges from basic to applied research, and its mission is carried out by 24 research divisions in five major fields: crop production and processing, biological research and the environment, the Antarctic, energy, and transport and communications.

There are also 11 associations concerned with applied research in building, coal, concrete, dairy, fertilizer manufacture, leather and shoes, logging, meat industry, pottery and ceramics, textile services, and wool. In addition the Cawthron Institute is concerned with the microbial degradation of natural and man-made organic materials. DSIR encompasses activities in health, the social sciences, and scientific services such as forensic science. In general, DSIR covers the main areas of scientific activity defined by the National Research Advisory Council, which coordinates science policy and advises the Minister of Science and Technology on research priorities. The organization and activities of DSIR are described in *DSIR Research 1978*, published as DSIR Information Series No. 136 by the Wellington head office. A more complete review of the activities was published in *DSIR Research 1976*, which commemorated the department's 50th anniversary.

DSIR OCEANOGRAPHIC INSTITUTE

The Oceanographic Institute, until 1979 located at 177 Thorndon Quay, Wellington, P.O. Box 12-346, Wellington North, is scheduled to move into new waterfront quarters, next door to similarly new quarters of the Fisheries Research Division of the Ministry of Agriculture and Fisheries. Through 1979, the institute has been crowded into a series of sub-standard commercial buildings in an industrial section of Wellington. The move to new quarters will be most welcome.

The institute has a staff of 25 scientists, 13 scientific technicians, eight supporting staff and varying numbers of temporary employees. In addition, the Ministry of Transport (Marine Division) operates the research vessel *Tangaroa* to carry out the research programs of the institute. The *Tangaroa* has a complement of eight officers, 13 seamen, and can carry a scientific complement of eight.

The staff is divided into eight scientific groups: benthic ecology, coastal and sheltered water environments, lake surveys, physical and chemical oceanography, plankton primary production, offshore minerals and geochemistry, sedimentology, and regional and local marine geology. The director is Dr. D. E. Hurley, a biologist who has specialized in the study of amphipods. Established to investigate the seas around New Zealand, the work of the institute has developed along three main lines–physical oceanography, marine biology, and marine geology. The activities of the institute have been expanded to include lake studies, and they have adapted marine techniques to New Zealand limnology. The marine research incorporates studies of water masses, currents, tides, tsunamis, living organisms, and the ocean floor and processes involved in its development.

The scientific staff includes five in physics, eight (one temporary) in geology, and 12 in biology, one a visitor. Some of the current projects follow:

GEOLOGY

Dr. D. J. Cullen is basically a sedimentologist who has a marginal interest in geophysics, using the tools of geophysics to investigate geological problems. He has been making purely academic studies of sediment movements, but he is also involved with applied geology and with recommendations on ocean dumping permits, although the Ministry of Transport is responsible for issuing the permits. He is currently investigating phosphorite deposits on the Chatham Rise, in northern New South Wales coastal waters (in collaboration with Flinders University, Bedford Park, South Australia), and in water near Cook Island.

The phosphorite deposits on Chatham Rise show promise for commercial production. In 1978 the West German research vessel *Valdivia* conducted an intensive survey of two small areas on the rise, totaling 227 square kilometers. During the one-month survey they recovered 689 samples in about 400 meters of water, which would extrapolate to 100,000,000 tons along 179-180° east of New Zealand's South Island. The processes by which marine phosphorite deposits are formed are still uncertain, but they probably start as sheets of limestone which become broken up and are then impregnated by phosphates. As a potential commercial fertilizer, phosphorite nodules have the advantage of requiring no processing other than grinding. The environmental impacts of large quantities of phosphorite are unknown, but because of the nutrient elements involved, the biological consequences could be substantial.

Dr. L. Carter is working on sedimentation and sediment transport processes in several areas, including the Maui Platform (with Dr. R. A. Heath of the physics group), the alongshore and offshore transport and deposition of sediment off the South Island, and the transport and deposition of Hutt River sediment. Carter is interested in the interaction between deep-water and sediment movements; he uses a tripod instrument stand to support current meters, TV cameras, photographic cameras, etc., above the bottom to record the simultaneous movement of water and of sediment.

Carter has acted as a consultant to the New Zealand delegation to the Law of the Sea Conference. New Zealand's continental shelf and 200-mile economic zone are enormous—probably the fourth largest in the world. This continental land mass, including the Chatham Rise and the Campbell Plateau, has similarly enormous economic potential, but it is largely unexplored. Oceanographers of the division are attempting to delineate the extent of the New Zealand continental land mass on the basis of geophysical data (rather than legal definitions) and to evaluate the resources of the area. Carter is also attempting to estimate and evaluate New Zealand ironsands, and in 1979 he worked on the transport of seston beneath the Ross Sea ice shelf [seston is a small, suspended particulate matter of organic (living or dead) or inorganic matter].

Dr. G. Glasby, who in 1979 was overseas as the holder of a Humboldt fellowship, is an authority on the origin and occurrence of manganese nodules in the South Pacific and is doing research on the marine geochemistry of the New Zealand region.

BIOLOGY PROGRAM

Several biologists of the institute are working on the systematics of marine organisms: brachiopods (Dr. J. Richardson); crinoids, echinoids, and echinoderms (D. G. McKnight); deepwater brachiopods, stonecrabs (E. W. Dawson); cirolanids (fish lice) (Dr. K. P. Jansen); and copepods (Dr. J. Bradford). Dr. Bradford, working with Dr. Heath, has initiated studies to model the West Coast upwelling ecosystem. She is also investigating the structure of East Coast upwelling and its relationship to nutrient and chlorophyll distributions and zooplankton composition. Dr. Bradford's charts of the distributions of reactive phosphate, phytoplankton (actually chlorophyll), and zooplankton show a number of anomalous areas off the west coast of the South Island; presumably these are related to upwelling zones, but they are also regions of squid fisheries by the Japanese.

E. W. Dawson specializes in benthic studies—benthos distributions, modelling, regional (Campbell Plateau, Chatham Rise) fauna, and the trophic structure of bottom communities.

PHYSICAL STUDIES

B. R. Stanton of the physics group is studying the frontal zones north of New Zealand, internal waves and tides, fjord and estuarine circulation, and coastal climates. A. E. Gilmore is concerned with microstructure and layering in the ocean, Ross Ice Shelf and McMurdo Sound sea temperatures, and supercooled water in the Ross Ice Shelf region. Dr. R. A. Heath is working on tides, fronts, currents, hydrology, and wind-driven upwelling.

A significant part of the function of NZOI is the production of charts in five series:

			Issued to 1 Jan. 79
COASTAL SERIES	Bathymetry	1: 200,000	28
	Sediments	1: 200,000	10
OCEANIC SERIES	Bathymetry	1:1,000,000	20
	Sediments	1:1,000,000	1
ISLAND SERIES	Bathymetry	1: 200,000	17
LAKE SERIES		Various scales	35
MISCELLANEOUS SERIES		Various scales	52

The miscellaneous series include charts of bathymetry, currents, sea surface temperatures, sediments, tsunami travel times, magnetic field and magnetic anomalies, salinity, tectonics, dynamic height anomalies of the sea surface, manganese deposits, metalliferous sediments, submarine volcanism, submarine geothermal activity, zooplankton biomass, primary productivity, tidal currents, reactive phosphorus, and phytoplankton standing crop (chlorophyll *a*). The charts are listed in *Miscellaneous Publication* NZOI #86. They can be purchased from the Publications Office, NZOI, P. O. Box 12-346, Wellington North, New Zealand.

Other publications of NZOI are:

(1) *Contributions* issued as *Collected Reprints* (1-30 issued in 1952-57; 491-523 issued in 1977)
(2) *Memoirs*, published by N.Z.D.S.I.R.
(3) *NZOI Records.* Instruments and method papers; species check lists; faunal lists; systematics papers; local water chemistry and geochemistry papers; sediment analyses, etc.
(4) *NZOI Oceanographic Summaries*
(5) *NZOI Oceanographic Field Reports*
(6) *Occasional Reprints*
(7) *Miscellaneous Publications*

R. V. *TANGAROA*

The research vessel *Tangaroa* is operated and manned by the Ministry of Transport. She was launched in Germany in 1960 as a fully refrigerated cargo vessel. She was purchased by the New Zealand government in 1972 and converted to an oceanographic research vessel in 1972-73 by Whangarei Engineering, Ltd., Whangarei, N. Z.

General specifications: Length overall, 246 ft; height overall 86 ft 6 in.; freeboard 7 ft 11 in.; maximum draft 12 ft 5 in.; net registered tonnage 296; gross 1012; main engine, "Deutz" 6-cylinder diesel, 1600 shp at 320 rpm; full speed 13 knots; service speed 11 knots; complement, eight officers, 13 men, six scientists; range 5300 nautical miles; endurance 20 days.

Equipment: Sampling–grabs, trawls, dredges, corers, and overside A-frames. Winching facilities–four modified cargo winches hydraulic, 26 and 52 rpm. Pull at 26 rpm = 773 lb. Pull at 52 rpm = 1,943 lb. Capacity

6,443 m of 6-mm chain for wire; one deep-sea winch 30 rpm. Pull 4,000 lb. Small drum capactiy 5,661 m 6-mm wire. Large drum capacity 16,230 m 6-mm wire. Navigational–radar 48 miles; satellite navigation system; doppler log. Survey and search–3.5 kHz, 12 kHz, 50 kHz sounders; TV; cameras side scan; magnetometer, air gun, and explosion seismic.

Facilities: physical–deck laboratory, laboratory below; geological–laboratory below; photographic–dark-room; data processing–P.D.P. 11; electronics–laboratory below.

The use of the *Tangaroa* is shared with the Geophysics Division, 30 ship days each year, and an equal amount of time is given to outside organizations such as other governmental units and universities. One such cruise has been carried out in conjunction with the Geological Survey (also DSIR), investigating ancient beach lines around the islands.

The Oceanographic Institute also cooperates with the CCOP/SOPAC (Committees for Coordination of Joint Prospecting for Mineral Resources in Asian and South Pacific Offshore Areas), by supplying one to two men per year to work on their projects. Dr. Glasby was recently involved in surveys of manganese nodules and precious corals as part of this program.

The institute performs a large number of service functions, such as advising on problems of marine pollution, assisting the Navy with oceanographic data and expertise, preparation of bibliographies, advising on dredging operations and thermal pollution, oil spills, etc.

The New Zealand Oceanographic Institute is well-known internationally, and their staff members have worked with American scientists from a number of institutions. Although the number of scientists is small and the national involvement in the oceans is large, the staff is first class and they are working effectively on a group of significant problems.

DSIR GEOPHYSICS DIVISION

The main laboratories of the Geophysics Division are at *Observatory Reserve, Salamanca Road, P. O. Box* 1320, Wellington, a beautiful hilltop site overlooking the city and harbor. The division has a staff of about 80 scientists and technicians and eight support persons. In addition there are about 20 more people at observatories at Apia, Western Samoa, and Rarotonga in the Cook Islands.

The division is comprised of the drilling section, the geophysical survey, the seismological observatory, the Apia and Rarotonga observatories, and geophysics and geothermal laboratories.

Most of the activities of the division are concerned with solid earth geophysics, but the Geophysical Survey has a small marine geophysics section. Major projects of the division are the monitoring of earthquakes by the seismological observatory and studying the variation of earthquake activity in the islands; the location and estimation of the size of geothermal fields; assistance in exploration for oil and coal; studies of groundwater availability; geophysical studies at engineering sites; and energy-involved activities, particularly explorations for coal and of geothermal fields.

The director of the division is Dr. Trevor Hatherton, who holds both D.Sc. and Ph.D. degrees from the University of London. Dr. Hatherton has had long experience in geophysics in New Zealand and also in the Antarctic, where he helped establish New Zealand's Scott Base.

The Geophysical Survey produces gravity and magnetics maps at scales of 1:250,000 and 1:1,000,000. New Zealand is very active seismically with many faults, volcanoes, and earthquakes. The North Island is a region of volcanic chaos, the South Island one of glacial chaos, making the geologic interpretation from surface features very difficult. Detailed gravity and magnetics are thus useful in interpreting the geology.

The marine geophysics group includes David Bennett and F. J. Davey, head of the section. Much of the work is with data collected by others, but there are usually two geophysical cruises of 15 to 20 days each year on the *Tangaroa*. The group is capable of all geophysical techniques except heat flow measurements. Dr. Davey has worked closely with geophysicists from Lamont Geological Observatory of Columbia University, and the group is interested in cooperative research in areas where their funding or technology is inadequate. Examples are two-ship refraction observations, ocean bottom seismographs, and multichannel seismic profiling systems.

The marine geophysics group has begun reconnaisance surveys of the New Zealand continental shelf, an area about seven times the size of the land area. They are using data from the *Tangaroa* and from various visiting ships, including the *Eltanin* (now the *Islas Orcadas*), and ships from Lamont-Doherty Geological Observatory and Woods Hole Oceanographic Institution. In addition, some data are available from commercial surveys.

A cooperative survey of the Lord Howe Rise was carried out in 1978 with Australian and German geophysicists, using multichannel profiling equipment on the German ship *Somme*, a sister of the *Valdivia*. There is considerable economic interest in the Lord Howe Rise, the Chathan Rise, and the area north of East Cape, so continued geophysical surveys are desired. Also, New Zealand has a continuing interest in the Antarctic, and Davey will probably participate in a similar cooperative cruise to Antarctica. If so, he would hope to work on the eastern margin of the Campbell Plateau, which reaches southeastward from the southern top of the South Island.

Jean Filloux (formerly of Scripps Oceanographic Institution) is interested in marine magnetotellurics and is proposing such a survey of the Bay of Plenty. He also proposes a heat flow survey in the Bay of Plenty to determine the submarine continuation of the terrestrial geothermal zone.

Although traditionally the Geophysics Division has emphasized the geophysics of the land, there is an increasing interest in marine aspects, heightened by the recognition of the economic potential of New Zealand's continental shelf area and 200-mile economic zone.

THE PARI ISLAND RESEARCH STATION
NATIONAL INSTITUTE OF OCEANOLOGY, INDONESIA

Francis A. Richards

The information on the Pari Island Research Station was made available by Mr. A. G. Ilahude, Associate Director of the National Institute of Oceanology, Indonesia. We are greatful to him for his help.

The Pari Islands are located in Jakarta Bay about 35 km northwest of Jakarta. The islands are the most southern of the Seribu Islands–a chain of more than 100 islands extending NNW-SSE across the Java Sea (Figure 1). Pari Island is a pseudoatoll consisting of five small islands and two large and seven small lagoons.

Since 1962 the National Institute of Oceanology has conducted research–mainly on the biosystematics of marine biota–in the Seribu Islands. In 1968 a seaweed culture experiment was started in the Pari Islands, and research activities there have continued ever since. Subjects included are biosystematics, oceanography, biology, mariculture, sedimentology, and ecology. In November, 1976, the Pari Island Research Station (PRS) was established. PRS is part of the National Institute of Oceanology of the Indonesian Institute of Sciences.

RESEARCH FACILITIES

PRS has 680 m^2 of working space in five separate units (Figure 2):

Unit 1: five 3 x 4 x 0.5 m culture tanks. Running sea water is pumped from 500 m off shore, on the reef flat.
Unit 2: an oceanographic laboratory.
Unit 3: a biological laboratory, an aquaculture laboratory, and a store room.
Unit 4: a library, an administration room, a head room, a lecture room, and toilets.
Unit 5: two living quarters for technicians and scientists. The units can accommodate 10 and nine persons, respectively. Each living quarter has bedrooms, living room, dining room, bathrooms, and a kitchenette.

PRS has a speedboat–*Pulau Pari* II– for transportation between Jakarti and Pari Island. The boat is 5.80 m long and 2.20 m wide, and can accommodate eight passengers and two crew.

For working on coral reefs, the station owns three working boats:

Mutiara III–equipped with a 40-hp outboard motor; can accommodate six to eight persons.
Zodiac rubber boat–equipped with a 20-hp outboard; can accommodate six to eight persons.
Pulau Pari I–a sailing boat, but it can also be equipped with a 10-hp outboard motor and can accommodate two to three persons.

A Furuno radio communication system was recently set up for daily communication between the station and the NIO office in Jakarta.

Electricity is supplied by three generating sets:

One Daf generating set–55 KVA capacity with output of 220 V,

One Petter generating set–12.5 KVA capacity with output of 220V, and
One Honda generating set–1.5 KVA capacity with output of 110 V.

For further information on research opportunities write to:

The Director
National Institute of Oceanology
Jalan Pasir Putih 1, Ancol Timur
P.O. Box 580/DAK, JAKARTA UTARA
INDONESIA
Phone: 683850–680859
Cable: LONAS

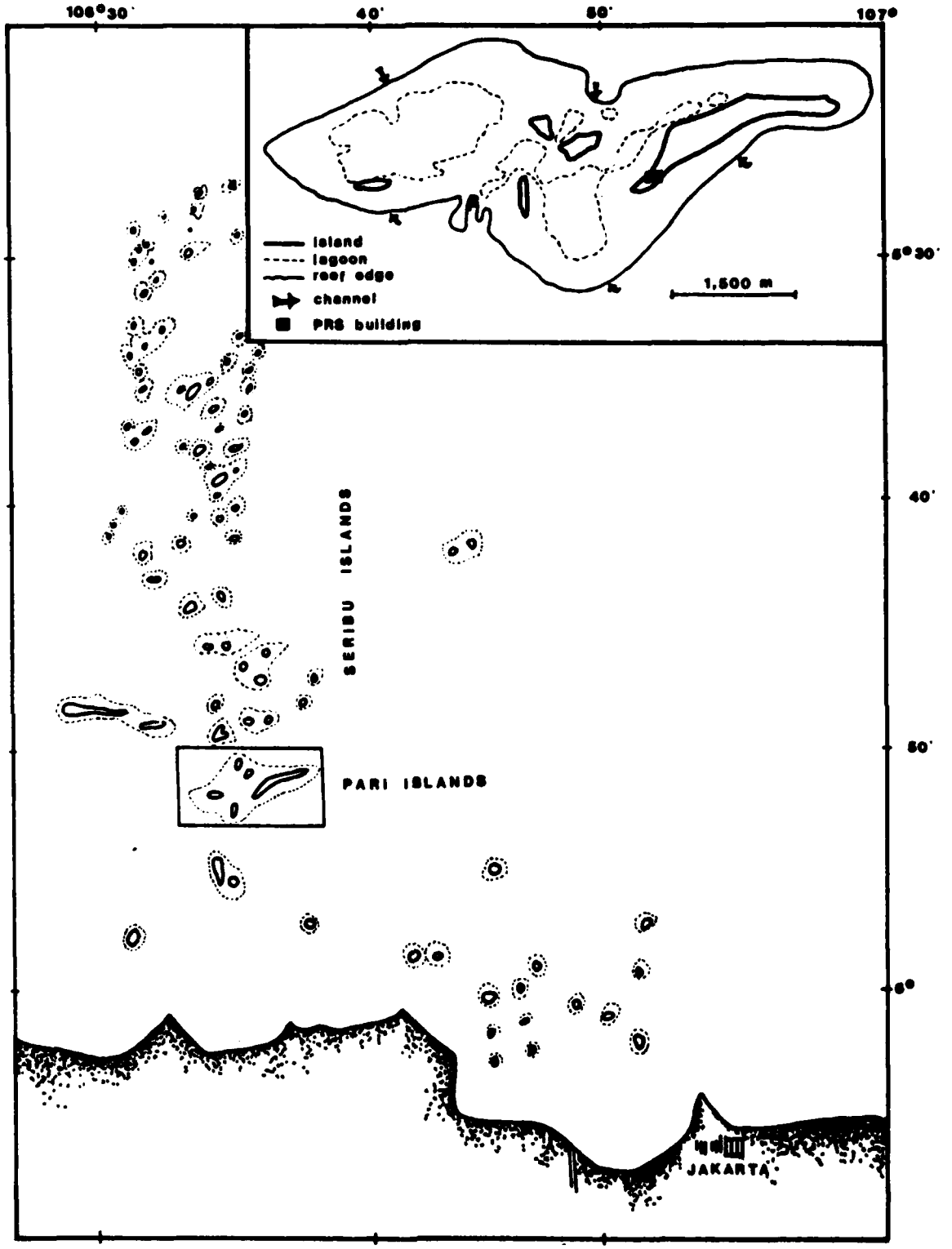


Figure 1. Seribu Islands and Location of PRS at Pari Island

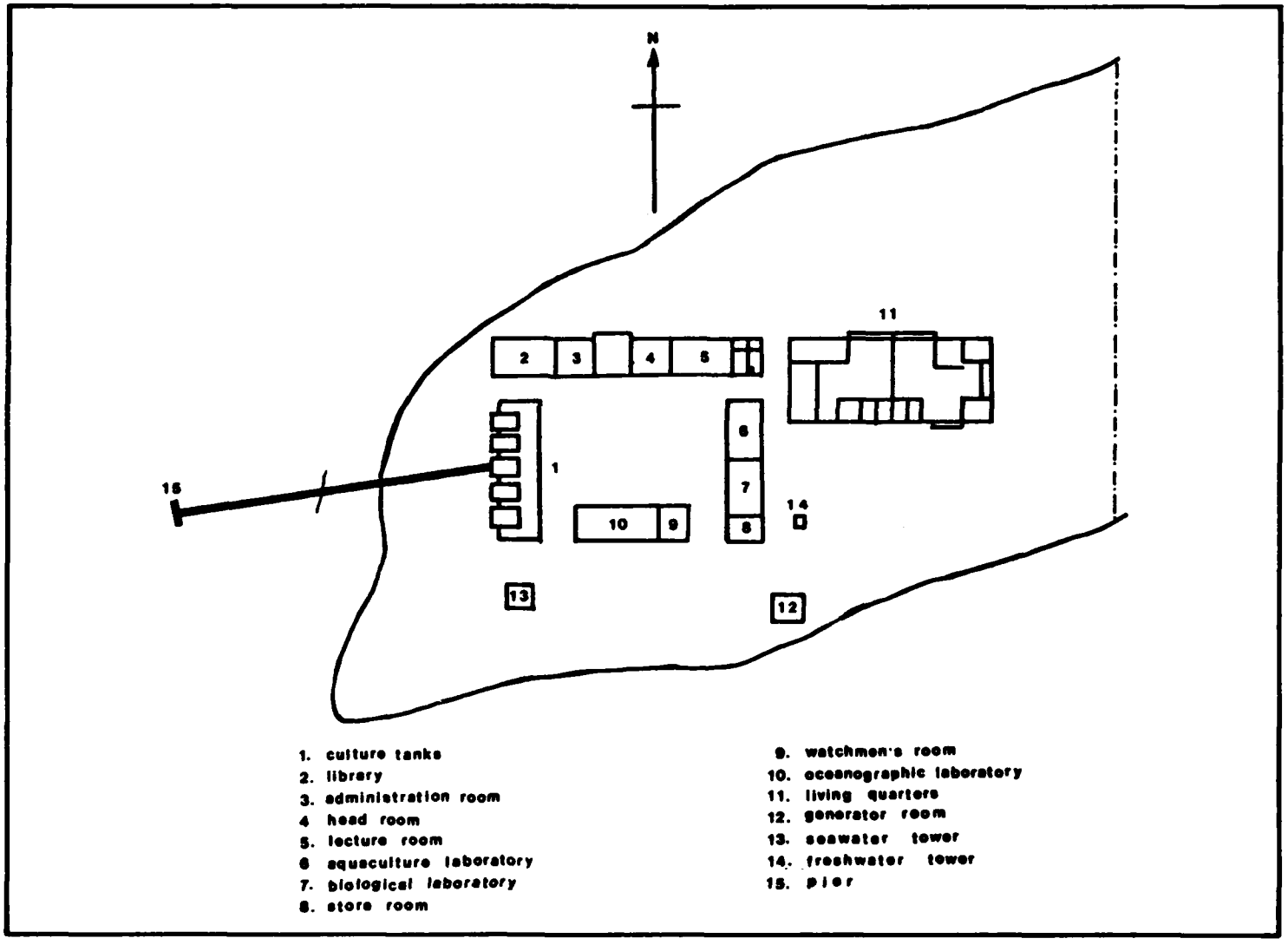


Figure 2. Group Map of PRS Building.

MARINE SCIENCES AT TŌHOKU UNIVERSITY, SENDAI

Francis A. Richards

The principal activities in marine science at Tōhoku University are in the Fishery Science Department of the Faculty of Agriculture and in the Geophysics Department of the Faculty of Science. There is also some marine-oriented work in the departments of chemistry and of geology and paleontology.

The Faculty of Agriculture had its beginning as the College of Agriculture, founded in September, 1907, three months after the Tōhoku Imperial University was formed. The College of Science came later–January 1911. The university was reorganized into the present faculty system in 1949. There are now 10 faculties with corresponding divisions in the graduate school and the college of general education. Each faculty has a dean who is also director of the corresponding graduate school division. There are also eight specialized research institutes.

As is common in Japanese universities, the faculties are departmentalized, with several chairs in each department. A chair is normally held by a professor, who has a coterie of one or two assistant or associate professors, a few research associates, and a group of graduate students.

There are chairs of seismology, geomagnetism and geoelectricity, meteorology, and physical oceanography within the Geophysics Department. I visited Professor Yoshiaki Toba, professor of physical oceanography. His associate professor, Dr. Takashige Sugimoto, is now on leave and working with Professor Takashi Ichiye of Texas A&M University. Research associates are Sanshirō Kawai, who has a master's degree from Kyoto University, and Kuniaki Okuda.

Professor Toba moved to Tōhoku University from Kyoto University in 1971 and represents a different lineage than many of the Japanese physical oceanographers whose roots are in Tokyo University. In the early 1930's both Koji Hidaka and the late Takaharu Nomitsu were studying ocean currents and publishing papers in the *Journal of the Kobe Marine Observatory*; there were scientific disagreements between the two men, and in 1931 Nomitsu founded an oceanographic laboratory at Kyōdai (an accepted contraction of Kyoto Daigakko–Kyoto University; similarly Tōdai). Hidaka ended up at Tōdai and eventually founded the Ocean Research Institute (Kaiyō Kenkyu-sho). In 1947 Shōichirō Hayami succeeded Nomitsu, who had retired two years earlier. Hayami had been at the Shanghai Science Institute where he did research on the hydrology of the Yangtze River and coastal oceanography. He thus was a pioneer in the field of boundary processes, both the estuarine boundary and the air-sea interface. His successor at Kyoto is Hideaki Kunishi, who formerly studied wind waves but whose main interest now is in coastal processes.

Toba left Kyoto to become head of the Physical Oceanography Laboratory at Tōhoku, which is mostly dedicated to the study of air-sea boundary processes, particularly with the problems of wind wave formation and wind wave dynamics. His earlier work was concerned with the formation of bubbles in the ocean, and he was among the first to formulate the configuration of floating and bursting bubbles. He is now concerned with the problem of transfer of energy from the wind to the ocean on scales from the thickness of the surface boundary layer to the mesoscale (on the order of 1000 km) and with oceanic variability of surface origin. Coastal processes are the special interest of Dr. Sugimoto, who was studying the exchange of water between the coastal area and the open ocean and between the Kuroshio (warm) current and cold-cored Kuroshio eddies. His estuarine studies have been aimed at understanding the movement of particles within the salt wedge, which is characteristic of the seaward part of an estuary and is made up by the intrusion of seawater along the bottom of the mouth of the estuary. The salt wedge is generally affected by the tide, which produces an oscillation of the salt

water-freshwater gradient up and down the estuary with the tide. The effects of boundary geometries on tidal currents and tidal mixing are of particular interest in the studies at Tōhoku.

There is some participation by Professor Toba and his staff in field studies, mostly concentrated on studies of the meandering, and water exchanges, of the Kuroshio. With no research vessel of their own, the work is generally in collaboration with other laboratories and aboard the research vessels of the University of Tokyo and Tōkai University. My impression was that much of the greater emphasis of Professor Toba's group is on model studies, and to this end an impressive group of laboratory models and tanks has been built up.

One of the models is a small rotating basin, 1 meter in diameter, in which the coast of Japan and the Kuroshio current can be simulated. The current itself, eddies, coastal mixing, and vortex formation can be produced in the model, which can rotate at variable speeds in either direction. Water motions are recorded by a camera that rotates with the model.

A small wind wave tunnel is 8 meters long, 15 cm wide, and has a water depth of 70 cm with a 17-cm height of air above the water. Variable wind speeds of up to 15 meters/sec can be generated; 4, 8, and 10 meters/sec are generally used, but at much higher speeds the water splashes and useful observations are impossible. Both sugar and salt solutions have been used to model two-layer systems for studies of the development of mixed layers and of turbulence.

A tank of similar dimensions has been used to model estuarine salt wedge formation and estuarine mixing.

The pride of the laboratory is their large wind-wave tunnel. It is housed in a separate building; the tunnel is 20 meters long, 60 cm wide, and has a water depth of 70 cm and an air travel height of 50 cm. Wind speeds of 16 meters per second can be used; these correspond to about 30 meters per second (about 0.6 knots) in the real ocean. The large tunnel has an independent wave generator so that wind stresses can be applied to mechanically generated water waves. The water wave generator has recently been updated with an electrically driven oil pressure drive system. The generator can produce waves with a maximum of eight components upon which various wind speeds can be impressed. The sensor systems include hot film anemometers for turbulence measurements, resistance-type wave gauges, and Pitot tube wind-speed sensors. These are deployed in a three-dimensional matrix within the tunnel and recorded in digital and analog forms for computer analysis.

Current research topics in the physical oceanography laboratory of the Department of Geophysics (also called The Geophysical Institute) include studies on the similarity of individual waves under the direct action of the wind; the stochastic form of the growth of wind waves in a single-parameter representation with physical implications (published by Toba in the *Journal of Physical Oceanography*); effects of boundary geometries on the intrusion of salt wedges; and studies on wind waves as a strongly nonlinear phenomenon. The publications from the laboratory appear in the archival, referred literature, and in *The Science Reports of the Tōhoku University, Series 5, Geophysics.*

The chair of oceanography at Tōhoku University is in the Department of Fishery Science of the Faculty of Agriculture. The laboratory is headed by Professor Satoshi Nishizawa and includes one assistant professor, Dr. Akira Taniguchi, two assistants, one technician, six graduate students, and three undergraduate majors. Nishizawa was originally a physicist, educated at Hokkaido University, Sapporo. From there he went to the faculty of fisheries of Hokkaido University, Hakodate, where he worked for 20 years in the laboratory of physical oceanography. But he fell under the spell of the dynamic Professor Sigeru Motoda, the dean of Japanese planktologists, and turned his interest toward the physical interactions of plankton communities. Moving to Tōhoku University in 1972, he is now applying his knowledge of physics to the solution of some important problems in biological oceanography.

One of the problems to which Nishizawa and his group have turned their attention is the vertical flux of particles in the ocean. Thus they are members of the rather large group of oceanographers who are investigating the design and use of sediment traps. They use traps equipped with a honeycomb baffle and a density gradient

of sodium chloride in the bottom, with formalin added to preserve the particles. The design seems to be similar to that being evolved at other laboratories interested in the vertical flux of particles.

A somewhat different approach to the vertical flux of particles is a laboratory system for separating and classifying large suspended marine particles according to their observed sinking rates. A series of vertical tubes of varying lengths (xylophone particle separator) is used to estimate the sinking rates of differently sized particles. One of the observations from the field and laboratory studies is that the large particles tend to sink more slowly and to lose density as they sink. Nishizawa presented a paper at the Spring 1979 meeting of the Oceanographical Society of Japan, comparing the vertical fluxes of particles versus particulate organic carbon. The work has also resulted in a master's thesis by Hiroshi Sasaki on "Direct observations of the vertical flux of particulate material in the sea off Sanriku."

Another line of research is an attempt to evaluate rates of phytoplankton growth in the absence of grazing pressures. Nishizawa and his staff have designed and deployed what they call a "Phytoplankton Resort Chamber" (PRC). The PRC is a 20-cm-diameter, 90-cm-long cylinder that has a buoyant collar some 20 cm from the top and a 5-kg weight to keep the cylinder in an upright position. The chamber is attached by a 5-meter tether to a buoy which is anchored to the bottom with a 20-kg weight and a conventional anchor. A fine net at the bottom of the cylinder is intended to exclude grazing herbivores, so that phytoplankton production within the resort and without grazing pressure can be compared with that outside the resort with grazing pressure. The first trials with the chamber have not been entirely successful because it is almost impossible to remove small zooplankton at the beginning of an experiment and to exclude them during the course of the observations. A preliminary report, "A study of grazing pressure exerted by natural zooplankton populations in Onagawa Bay by the use of a phytoplankton resort chamber," has been prepared.

Nishizawa has designed and constructed a towed instrument that he calls a SFTD—a scattering, fluorescence, temperature, and depth recorder. The towed package contains a mercury lamp light source that provides exciting energy at a wave length of 430 nm; fluorescence at 650 nm is sensed and recorded simultaneously in digital and analog forms on deck. In a trial of the instrument in the region of the confluence of the Oyashio and Kuroshio, where the surface water temperature was changing on an average of 1°C per nautical mile, patches of fluorescence 10 to 12 meters across were observed. The patches seemed to occur in pairs which appeared to enlarge and then divide. The instrument may have been towed through rather regularly spaced pairs of streaks, or the record could have represented rings. A nighttime test of the instrument near the Philippines indicated no such patches, but the background fluorescence was about the average of that observed within and without the patches. The instrument was built at a cost of about $25,000 and appears to have some advantages over fluorescence measurements in pumping systems, which tend to integrate the observations and smooth out the fine structure sensed by the towed instrument.

Other more conventional research projects in Professor Nishizawa's laboratory include studies of nutrient uptake kinetics (the laboratory has a nitrogen-15 analyzer for studying the nitrogen cycle).

Nobuo Suzuki, professor of analytical chemistry in the Department of Chemistry, Faculty of Science, has some interest in marine science, primarily in using new methods for the analysis of marine materials. His laboratory, which includes one assistant professor and two research associates at the D.Sc. level, is working in three main fields: activation analysis, the chromatographic behavior of metal chelates, and the effects of fundamental solution chemistry on solvent extraction and comparisons of the partition of chemicals during solvent extraction with their partition in biological materials. Among the specialized facilities of the university is an electron accelerator which produces a high flux of photons. This flux has been used for the nondestructive multielement photon activation analysis of various environmental materials, including rock materials, glasses, biological materials, and of deep-sea sediments. Ten to 20 elements per sample can be estimated by these methods.

The Department of Geology and Paleontology, Faculty of Science, has chairs of geology, historical geology, and paleontology. Professor Yokichi Takayanagi holds the latter chair and is a micropaleontologist specializing in

foraminifera. He has been involved in the Deep Sea Drilling Project (DSDP) and is a member of the panel on paleoenvironment of the International Program of Ocean Drilling (IPOD). Graduate students are working on fossils of planktonic foraminifera, and so they need information on living planktonic foraminifera, which are taken in plankton collections. Other students are working similarly on diatoms and coccolithophares.

Dr. Kazuo Taguchi, a geochemist in the Institute of Mineralogy, Petrology and Economic Geology, Faculty of Science, has studied the diagenesis of silica minerals in Neogene Tertiary shales from Hokkaido, geochemical relationships between Japanese Tertiary oils and their source rocks, and various other aspects of inorganic and organic diagenesis.

My overall impression of the parts of Tōhoku University that I visited was good. The university is scattered among some eight campuses, institutes, and laboratories in Sendai and 21 laboratories, observatories, etc., outside the city. The Faculty of Science occupies modern, multistoried functional buildings which suffered only slight damage in the severe earthquake of 1978. Laboratories appear generally well equipped, and the publications of the faculty are numerically impressive, and the ones I could evaluate make sound scientific contributions.

NOTO MARINE LABORATORY OF KANAZAWA UNIVERSITY

Ju-shey Ho

Although in Japan there are 23 marine biological stations that are maintained and operated by various national universities, only three of them are located in the western region facing the Sea of Japan. They are (from north to south): Sado Marine Biological Station of Niigata University, Noto Marine Laboratory of Kanazawa University, and Oki Marine Biological Station of Shimane University. Both Sado and Oki stations are on islands in the Sea of Japan, but Noto laboratory is in a resort town called Ogi on Noto Peninsula–the largest peninsula in western Honshu.

On a recent trip to Japan, I had the opportunity to work at two of these stations for four months, from August to November, 1978. Since one of the two stations that I visited, Sado Marine Biological Station, has previously been described in the *Scientific Bulletin* by Aubrey Gorbman (Vol. 3, No. 2, 1978) and Francis A. Richards (Vol. 4, Nos. 1 and 2, 1979). I shall treat here only the Noto Marine Laboratory.

BRIEF HISTORY

Although a marine station on the Noto Peninsula had been planned for quite some time, construction was not diligently pursued until 1956 when Professor Masao Kumano of the then department of biology at Kanazawa University made a laborious survey of the biota, geology, and environment of many parts of the peninsula. He eventually selected, in 1957, the picturesque Tsukumo Bay (bay of *ninety-nine* indentations) for the home of the first marine station to be built on the entire coast of the Sea of Japan.

The laboratory was officially opened on July 5, 1958, and has since gone through three phases of growth. In the beginning the laboratory occupied eight wooden buildings (637 m^2) that were relocated to a piece of waterfront land (29,700 m^2) on Tsukumo Bay. The land was donated by the town of Uchiura, and the wooden buildings were given to the laboratory by the Japan Sea Regional Fisheries Research Laboratory of the Ministry of Agriculture, located in a town nearby called Wakura. Ten years later in 1968, a new concrete blockhouse (52 m^2) was added to the complex for the purpose of culturing and maintaining experimental organisms. Five years later, the old wooden buildings were taken down and replaced by two concrete buildings of two stories–a research building (656 m^2) and a dormitory (497 m^2). In addition, a boathouse (80 m^2) was erected near water. Thus, the Noto Marine Laboratory of today was completed and dedicated on December 26, 1972.

Noto Marine Laboratory has been administered by six directors since its founding in 1958. They are (in chronological order): Hiroshi Kawashima (1958-1959, acting director), Masao Kumano (1959-1961, zoologist), Genkei Masamune (1961-1963, botanist), Kojiro Nishida (1964-1966, algal physiologist), Kikuya Mashiko (1966-1974, ecological physiologist), and Saburo Isaka (1974-present, animal physiologist). Currently, Dr. Isaka heads a permanent staff consisting of one assistant (Dr. Masahiko Ikemori) and three clerical-technical staff (Tsutomu Shinya, Masahiro Matada, and Hisao Kusunoki).

SURROUNDINGS AND BIOTA

Tsukumo Bay is on the east coast of Noto Peninsula about 30 km from its tip. Though small in area (1 km from east to west and 1.5 km from north to south), the bay has a comparatively long shoreline (about 4 km). Its shores are greatly indented, and the laboratory is located at an indentation called "Funa-kakushi" (boat hiding). The mouth of the bay is about 200 m wide, and the depth of the bay is 25 m.

The warm Tsushima Current that flows northward along the coast of western Honshu branches out a subcurrent off the tip of the peninsula. This subcurrent then turns around and flows southward along the east coast of the peninsula into the large Toyama Bay. Since there are cold upwelling waters ascending from the great depth of Toyama Bay off the east coast of the peninsula, the biota in the vicinity of Tsukumo Bay has rich warm-temperate elements with a strong cold-temperate influence.

Tsukumo Bay is primarily a rocky shore with muddy bottom, but along the east coast of Noto Peninsula, within a distance of 20 km north and south of Tsukumo Bay, there are many places with sandy, sandy-muddy, or gravelly shores. Therefore, a biota rather rich in varieties of animals and plants for a temperate zone is found near the laboratory. It is possible to collect year-round in Tsukumo Bay as the water in the bay remains calm even in the winter, when the severe northwesterly wind from Siberia kicks up a rough sea just outside the bay.

The invertebrates that are easily gathered by shore collecting around Tsukumo Bay are: sea anemones (*Anthopleura midori*), polychaetes (*Chloeia flava, Hesione reticulata, Marphysa sanguinea,* and *Acrocirrus validus*), gastropods (*Scutus sinensis, Tristichotrochus unicus, Monodonta labio, Omphalius rusticus, Serpulorbis imbricatus,* and *Thais bronni*), sea hares (*Aplysia kurodai, Glossodoris pallescens, G. festiva,* and *Dendrodoris nigra*), mussels (*Mytilus edulis*), hermit crabs (*Pagurus similis*), crabs (*Charybdis japonica*), brittle stars (*Ophioplocus japonicus*), sea stars (*Centronardoa semiregularis, Asterina batheri,* and *Coscinasterias acutispina*), sea urchins (*Hemicentrotus pulchrrimus* and *Anthocidaris crassispina*), and tunicates (*Botrylloides violaceus*). Additional invertebrates that are readily available by shore collecting within 20 km from the laboratory on the coast outside of Tsukumo Bay are: sponges (*Callyspongia elongata*), sea anemones (*Cerianthus filiformis*), flat worms (*Plancera reticulata*), ribbon worms (*Lineus fuscoviridis*), polychaetes (*Arenicola brasiliensis*), sea hares (*Bursatella leachii*), bivalves (*Barbatia virescens*), barnacles (*Mitella mitella*), and shrimps (*Rhynchocinetes aritai*).

The algae that are easily gathered by shore collecting around Tsukumo Bay are: green algae (*Ulva pertusa, Enteromorpha intestinalis, E. linza, Caulerpa okamurai,* and *Codium fragile*), brown algae (*Padina japonica, Nemacystus decipiens, Scytosiphon lomentarius, Colpomenia sinuosa, Hydroclathrus clathratus, Sargassum piluiferum, S. patens, S. tortile, S. serratifolium, S. confusum* and *S. thunbergii*), and red algae (*Gelidium amansii, Pterocladia capillacea, Corallina pilulifera, Grateloupia filicina, Hypena charoides, Gymnogongrus flabelliformis, Centroceras clavulatum,* and *Laurencia intermedia*). Additional algae that are readily available by shore collecting within 20 km from the laboratory on the coast outside of Tsukumo Bay are: brown algae (*Padina arborescens,* and *P. crassa*) and red algae (*Nemalion vermiculare, Gracilaria textorii, Champia japonica, Wrangelia argus,* and *Chondria crassicaulis*).

Many other species of invertebrates and algae are available from the bay and its neighboring coast if collecting is done with scuba diving or dredging. Some of the animals and plants that are frequently collected for use in teaching and research at Noto Marine Laboratory are only available with this method of collecting. Those are: sea anemones (*Anthopleura japonica, Boroceroides mcmurrichi, Haliptanella luciae,* and *Heteranthus japonicus*), sea urchins (*Clypeaster hilgendorfi, Pseudocentrotus depressus,* and *Temnopleurus reevesi*), sea stars (*Asterina pectinifera*), tunicates (*Halocynthia hilgendorfi* and *Styela plicata*), green algae (*Acetabularia calyculus*), and brown algae (*Chorda filum, Undaria pinnatifida, Ecklonia stolonifera, Myagropsis myagroides, Sargassum horneri, S. ringgoldianum,* and *Coccophora langsdorfi*). In 1973, a species of pogonophora (beard worm), *Oligobrachia mashikoi,* was discovered by dredging in Tsukumo Bay. It is worth noting here that this beard worm is one of only four species in the world that live in shallow water, less than 40 m; the great majority of them are inhabitants of the deep sea, living in a slender tube at a depth ranging from 1,000 to more than 3,000 m.

Jellyfishes can become very abundant in Tsukumo Bay. The most common species, *Aurelia aurita,* can occur in such a great density that a row boat can be brought to a standstill.

FACILITIES AND EQUIPMENT

The laboratory can accommodate up to 30 students at one time. It is used throughout the year but is particularly heavily occupied during the summer months. Students from the universities in Ishikawa and Toyama

prefectures are the main users. Occasionally, high school students are also seen at the laboratory, attending the marine workshop. Classes and workshops held at the laboratory are not offered by the staff of the laboratory but are taught by teachers and instructors who bring the students to the laboratory. The laboratory merely provides facilities and equipment for the classes workshops. The duration of the classes and workshops varies from one to two weeks; therefore, the laboratory can have several different groups of students in a given summer.

The laboratory maintains five boats that are used for both teaching and collecting research materials. They are: *Aosagi* (a 3-ton boat equipped with a 20-HP diesel engine), *Loligo* (a 0.7-ton boat equipped with a 3-HP diesel engine), *Karugamo* (a Japanese-style skiff equipped with a 5-HP outboard motor), *Zostera* (a Japanese-style skiff), and *Sekirei* (a small row boat for two persons).

In addition to the lecture hall and the general laboratory that are mainly used by the students attending the classes or workshops, there are in the research building five research rooms, a dark room, a temperature-controlled room, a general office, and the director's office. The detached concrete blockhouse contains a small laboratory, a cold room, a temperature-controlled room, and a culture room. All the research rooms and laboratories are supplied with seawater, fresh water, gas, and electricity.

While the students attending the classes and workshops at Noto Marine Laboratory study mainly the morphology, systematics, ecology, and general physiology of the marine organisms, the research activities of the staff are strictly biochemical in nature. Therefore, it is not surprising to find that the major research equipment at Noto Marine Laboratory consists of instruments for physiological studies. Both Dr. Isaka and his assistant, Dr. Ikemori, proudly told me that their institution is one of the best-equipped laboratories for biochemical research in Japan. Some major equipment that I saw at the laboratory are: a dual/double-beam spectrophotometer (Shimadzu, UV-300) with a data processor (SAPCOM-1), a split-beam spectrophotometer (Hitachi, Type 124), a differential spectrophotometer (Shimadzu, RF-503), a refrigerated centrifuge (Hitachi, 20-PR), an ultra-centrifuge (Hitachi, SSP-2), a lyophilizer (RFS-5009), and a Vanox microscope (Olympus) equipped with Nomarsky and fluorescence accessories.

RESEARCH INTERESTS

Dr. Isaka's research interest lies in the fertilization of sea urchin ova. He has discovered that the jelly coat of sea urchin ova is mainly composed of a sialopolysaccharide-protein complex, which is responsible for causing isoagglutination and acrosome reaction in sea urchin spermatozoa. Recently, he found that there are enzymes of certain glycosidases present on the surface of sea urchin spermatozoa. These enzymes, including sialidase, are suspected to be responsible for sperm-isoagglutination in egg water. Furthermore, he has also found that a trypsin-like enzyme and lipase are discharged at the onset of the acrosome reaction in the sea urchin spermatozoa.

Research on the mechanism of photosynthesis is also pursued at Noto Marine Laboratory. This is chiefly carried out by Dr. Ikemori, the resident algal physiologist. Both he and Dr. Isaka are trying to purify photosynthetic systems I and II from marine algae. They have, so far, succeeded in obtaining a clear separation of photosynthetic pigments in several species of marine algae.

VISITS TO TWO CHINESE RESEARCH INSTITUTES

Mitchel Weissbluth

Research and development in China is concentrated in the research institutes under the Chinese Academy of Sciences and to a much lesser extent in the universities whose primary function is teaching. I visited the Institute of Physics and the Institute of Biophysics, both in Beijing.

The Institute of Physics (Shih Ju-wei, Director) has a staff of 1200 organized into ten departments: solid state, magnetism, crystallography, low temperature, laser, infrared, high pressure, ultrasonics, plasma and theory. Among the projects I was able to see, a particularly impressive one was the work on the magnetic anisotropy of amorphous Gd-Co films carried out by a group under the direction of Wang Zhong-quian. The films, 400-800 Å thick, were prepared by bias sputtering on NaCl substrates. Studies included structure, obtained from measurements of elastically scattered electrons, and magnetic anisotropy, from hysteresis loops with the magnetic field perpendicular to the film surface. They conclude that the perpendicular anisotropy is due to a preponderance of Gd-Co atom pairs. Other investigations related to magnetism include magnetic bubbles and magnetic phase transitions. The solid state department is also active in the structure and properties of amorphous materials, semiconductors, and microwave ferrites. Closely related work in the crystallography department is devoted to crystal growth, x-ray diffraction, crystal defects, and elastic and optical properties. The low temperature group is mostly concerned with superconductivity–properties of Nb-Sn ribbons, Josephson junctions, and the development of an earthquake dector by a superconducting gravity meter. They have also recently constructed a dilution refrigerator. In the laser and infrared group, there are projects on holography, nonlinear optics, optical processing, semiconductor lasers, atomic physics, and Raman spectroscopy. Surface waves, ultrasonic holograms and high-power transducers are studied by the ultrasonic group. An apparatus for P-V studies at pressures up to 45 kilobars is being developed by the high pressure department and one of its interests is the static synthesis of diamond. The plasma department is studying laser-plasma interactions and has a small Tokomak under construction. Most of the theoreticians are attached to department which engage in experimental work. A smaller number, in a separate theory department, is working in relativity, gravitation, quantum field theory, elementary particles, relativistic electrodynamics, and lattice dynamics. Mention was also made of plans to build a high energy proton decelerator.

The Institute of Biophysics (Pei Shih-chang, Director), with a staff of 400 consists of seven departments: radiobiology, cell biology and fine structure of cells, technology, physics of receptors, experimental technology, and crystal structure. The radiobiology department is the largest. Included among its projects are the development of sensitive low-dose radiation dosimeters, extension and improvement of ferrous sulphate and thermoluminescence dosimeters, and construction of a whole body radiation monitor and an automated liquid scintillation counter. Using a ^{60}Co source, they are investigating the effects of low doses administered over long periods of time. The crystal structure department is engaged in x-ray diffraction studies of proteins. Of particular note is the work on porcine insulin whose structure has been refined to a resolution of 1.8 Å. They have recently acquired a Philips four-circle x-ray diffractometer equipped with an on-line computer for data processing. In the experimental technology department, an apparatus for electron paramagnetic resonance has been constructed. It is now being used for spin label experiments. Other projects include work for flash photolysis and the effects of γ-radiation on nucleosides.

A serious shortage of modern instrumentation was noted in both institutes. Until this is remedied, they make do with equipment built by researchers and their assistants. While providing valuable experience and an opportunity to duplicate known results, such equipment is inadequate for high-level research at the forefront of a field.

Beijing University is the most prestigious university in China. From a peak enrollment of 10,000 in 1965, it closed completely during 1966-1970 and gradually has climbed back to its present enrollment of 10,000. By 1985 the enrollment is projected to reach 20,000. In addition to regular courses, the university offers numerous short-term and refresher courses to non-matriculated students. Since 1978 admission has been based on an entrance examination, the basic program has been expanded to four years, and graduate studies have been resumed. There is no general study in physics; a student must select a particular specialty, e.g., low temperature physics, magnetism, laser physics, acoustics, nuclear physics, or theoretical physics. In contrast to previous years, the fundamental aspects are receiving more emphasis. There is no Ph.D. degree although there exists a three-year graduate program, half of it devoted to research, at the end of which a diploma is awarded.

The Chinese scientists I met are not at all reticent to discuss the tumultuous political history of their country during the last 10-15 years, and its effect on science and technology. They feel they have to make up the loss in time and the loss in the supply of young scientists. At the present time, the burden of research leadership still rests on those older scientists who were educated prior to the Cultural Revolution, many of them with advanced training outside of China. This situation will improve when the present crop of young scientists, who are being educated in China and abroad, complete their training and can occupy responsible positions in the research laboratories.

Staff Members and Specialty

INSTITUTE OF PHYSICS

Liu Chia-jui (Professor)	Plasma laboratory
Han Jian-kuo	Interpreter, administration
Lee Chia-ming	Solid state theory
Nie Yu-shie	Atomic physics
Li Yin-an	Plasma laboratory
Chen Li-chuan	Solid state, crystallography
Han Chan-shen	Laser spectroscopy
Fan Hai-fu	Crystallography
Wang Zhong-quian	Magnetic properties of amorphous films
Yu Zhe-hong	Magnetic bubbles
Pao Ken-shen	Magnetism
Chen Yi-huen (Professor)	Director (administrative)
Chu Chih-ying (Mrs.)	Interpreter, administration
Fan Hai-fu	Solid state
Gu Ben-yuan	Solid state theory, lattice dynamics
Jin Long-hoan	Amorphous materials
Chang Long-zhuen	x-ray diffraction
Wang Ju-ching	Liquid helium laboratory
Shen Chu-t'ung	Fusion laboratory
Ch'en Tsu-te	Fusion laboratory
Shu Chi-jen	Laser laboratory
Liu Yin-lieh	Magnetic bubbles
Mo Yü-chun	Crystallography

INSTITUTE OF BIOPHYSICS

Zhu Shao-nan	Radiation dosimetry
Zhou Ke-jian	Radiation dosimetry
Change Yin	Flash photolysis
Soong Jian-men	Whole body radiation monitor
Shen Wen-duan	Electron paramagnetic resonance

INSTITUTE OF BIOPHYSICS (Continued)

Wang Tei-cheng	x-ray diffraction of insulin
Wang Yu-ying	x-ray diffraction
Ma Yi-chin	Radiation effects on nucleosides
Do Shi-chi	Crystallography
Wu Bo-mu	Crystallography
Tsou Chen-lu	Molecular biology

SCIENCE AND TECHNOLOGY IN SOUTH KOREA

Mitchel Weissbluth

It is no mere coincidence that the expansion of education in South Korea during the last two decades followed the rapid growth of the economy. This is especially true of scientific and technical education, without which modern, industrial development is essentially impossible.

The Korean economy has been growing at an average annual rate of 10%, and exports have increased at an annual rate of 40%. Export products have included not only traditional items like textiles and shoes but also products of newer industries such as electronic devices, supertankers, steel, and automobiles. Seoul, the capital of South Korea, is, today, a modern, cosmopolitan metropolis with a population of some eight million people. The entire pattern of development is strikingly similar to that of Japan in the 1960's.

My hosts in Korea were kind enough to arrange a tour of a few industrial enterprises: the Pohang Iron and Steel Co., Ltd. (POSCO), the Hyundai Shipbuilding and Heavy Industries Co., Ltd., and the Gumi Export Industrial Corporation. POSCO is located on the east coast near the city of Pohang, some 200 miles southeast of Seoul. The plant began operating in 1973 at an annual production capacity of 1.03 million tones of crude steel; it is now operating at 5.5-million-ton capacity and is engaged in further expansion to achieve 8.5 million tons by 1981. About 40 miles further south, near Ulsan, there is a concentration of heavy industry which includes the Hyundai shipyard and automobile assembly plant. The shipyard went into operation in 1973 and now has three huge drydocks, one of which is designed for the construction of ships up to one million DWT. The shipyard employs 32,000 people and has built semisubmersible drilling rigs, cargo ships, tankers, and various other types of vessels.

The Gumi Export Industrial Corporation, situated on 3100 acres near the city of Daegu, is the center of Korea's fast-growing electronic industry. The corporation manufactures a wide range of products from simple components to sophisticated instruments and appliances. It is gratifying to note that environmental and aesthetic considerations were not ignored and that considerable effort is being expended to provide housing, schools, recreational facilities, etc., for the employees.

It is against this background of a rapidly developing society that we must view South Korea's growth in the educational system—especially the scientific and technical component. Since the end of the Korean war, the adult literacy rate has been pushed to 90%, making it one of the highest in the developing world. During the 1960's, college and university education was greately expanded but there remain serious shortcomings. A recent survey conducted by a team of Korean professors indicated that, in the science and engineering areas the ratio of students to faculty was 43.6; the ratio would be even higher if one were to take into account only those professors who have had modern training. Still another problem is in laboratory equipment. The same survey indicates that the colleges had only 32.7% of the experimental equipment legally required. In consequence, their laboratory training is inadequate, and there is an undue emphasis on "book learning" and memorization.

There was ample evidence during my visit that these problems are being confronted. An important step in that direction is the establishment of various institutes of sufficiently high caliber to attract Korean students who had gone abroad for graduate work and who would not ordinarily return for lack of opportunity to make use of their specialized training.

The major academic research centers are the Korean Advanced Institute of Science (KAIS) and Seoul

National University (SNU). Some of the other important institutes include the Korea Institute of Science and Technology (KIST), which is intended primarily to provide technical support for industry; the Korea Atomic Energy Research Institute (KAERI); and the Korea Scientific and Technological Information Center (KORSTIC), which is concerned with the collection and dissemination of scientific information. The Agency for Defense Development (ADD) undertakes defense-oriented research and development.

KAIS was established in 1973 as a graduate school in applied science and engineering. With a full-time faculty of 60, it now offers programs leading to Ph.D., Professional Engineer, and M.S. degrees in applied chemistry, applied physics, biological science, computer science and several branches of engineering. The current student enrollment is over 500. President Soon Tahk Choh was very proud to point out that KAIS enjoys a unique position among the institutions of higher learning in Korea in that it does not come under the jurisdiction of the Ministry of Education. It may, therefore, establish administrative procedures, organize the curricula, and manage its funds—provided by the government—so as to acquire the best faculty and students. Thus, faculty members are offered attractive salaries commensurate with their qualifications, free housing, and a guaranteed minimum research fund. Students also enjoy the special privilege of being exempt from the three-year compulsory military service and are provided with stipends sufficient to cover all educational and living expenses. In return, after graduation, students are obliged to serve for three years in the scientific-technological community related to industry or government.

Seoul National University is the most prestigious university in Korea. The new Kwanak campus was opened in 1976 and is located on the outskirts of Seoul, in an attractive park-like area which had previously been an elegant golf course. Of the 17,000 students, there are 2600 in M.S. and about 600 in Ph.D. programs. Professor Choochon Lee, a U.S.-trained, elementary particle theorist, is the chairman of the physics department. In a conversation with him, it rapidly became clear that SNU did not enjoy the privileges existing in KAIS. There are about 60 graduate students in physics, with a disproportionately large number doing theoretical work mainly because equipment for experimental research is woefully lacking. For the same reason, recruitment of faculty, particularly those trained abroad in experimental areas, is more difficult. Moreover, students are not exempt from military service. Nevertheless, the brain power seems to be there, and there are good reasons to believe that, in time, solutions will be found.

DYNAMIC PROPERTIES OF NUCLEIC ACID BASES

Mitchel Weissbluth

From modest beginnings in 1958, the Institute for Protein Research has become one of the most important research centers for the study of proteins on related subjects in biology and biochemistry in Japan. Since 1972, the institute has occupied a modern eight-story building on the new campus of Osaka University in the rustic town of Suita.

There are ten divisions and several supporting units; these are the divisions of physical chemistry, protein crystallography, molecular biophysics, organic chemistry, protein chemistry, enzymology, protein biosynthesis, physiology, protein metabolism, and the regulation of macromolecular function. The supporting units are laboratory methods, peptide center, and special common-use equipment.

The Division of Molecular Biophysics, under the direction of Professor Yoshimasa Kyogoku, concentrates on spectroscopic studies of proteins, nucleic acids, and other biological substances. They are well-equipped with modern, sophisticated instrumentation to conduct experiments by infrared, Raman, and nuclear magnetic resonance (NMR) methods. I shall describe one area of activity whose objective is to obtain information and understanding of certain dynamic processes in nucleic acids.

In the Watson-Crick model of DNA, complementary base pairs are interconnected by hydrogen bonds. Employing a variety of physico-chemical techniques, experimenters have accumulated a great deal of knowledge on such structures; however, the dynamic properties are considerably more difficult to investigate and are therefore less well-known. An important step to overcome this deficiency has been taken by Kyogoku and Hideo Iwahashi. Their method is based on proton NMR in a double irradiation configuration applied to relatively simple hydrogen-bonded nucleic acids in nonaqueous solvents.

It is known that 9-ethylguanine (9EG) and 1-methylcytosine (1MC) in dimethylsulphoxide (DMSO) will pair with each other through the formation of hydrogen bonds (Figure 1). Similarly, 9-ethyladenine (9EA) will pair with 1-cyclohexyl-5-bromouracil (5BrU) in chloroform and, to a lesser extent, in DMSO. Hence, these systems can be regarded as prototypes of purine-pyrimidine pairs in double-stranded polynucleotides such as DNA. Iwahashi and Kyogoku subjected these systems to a proton NMR experiment in which certain resonances were monitored at the same time that other resonances were being saturated. By this method, they were able to determine a number of qualitative and quantitative characteristics of proton exchanges between nucleic acid bases.

The principle of the experiment may be clarified by referring to the C-G pair shown in Figure 1. Attention is focused on three groups of protons: the two amino protons of 1MC, the imino proton of 9EG, and the two amino protons of 9EG. In an NMR experiment, these three groups of protons are distinguishable because their microscopic environments are not identical; hence, their chemical shifts differ slightly. One may now apply sufficient rf power to saturate the resonance associated with a particular group of protons. Ordinarily, in simple systems, the saturated resonance suffers a loss in signal strength while the rest of the spectrum remains unaffected. However, in the present case, saturation of the resonance of the imino proton in 9EG not only caused a loss of intensity of the imino proton signal but also a loss in intensity of the signal associated with the amino protons in 1MC. It is as if there has been a transfer of saturation from the imino proton in 9EG to the amino protons in 1MC. According to the theory of such saturation transfer processes, the imino proton in 9EG must be reversibly exchanging with an amino proton in 1MC, and the exchange rate must be occurring at a more

rapid rate than the spin-lattice relaxation rate. A preliminary account of such experiments was given in a paper by H. Iwahashi and Y. Kyogoku in Nature, *271*, 277 (1978). Further experiments have been conducted more recently; we summarize the salient results and interpretations.

1. Proton exchange takes place between an amino proton in 1MC and the imino proton in 9EG.

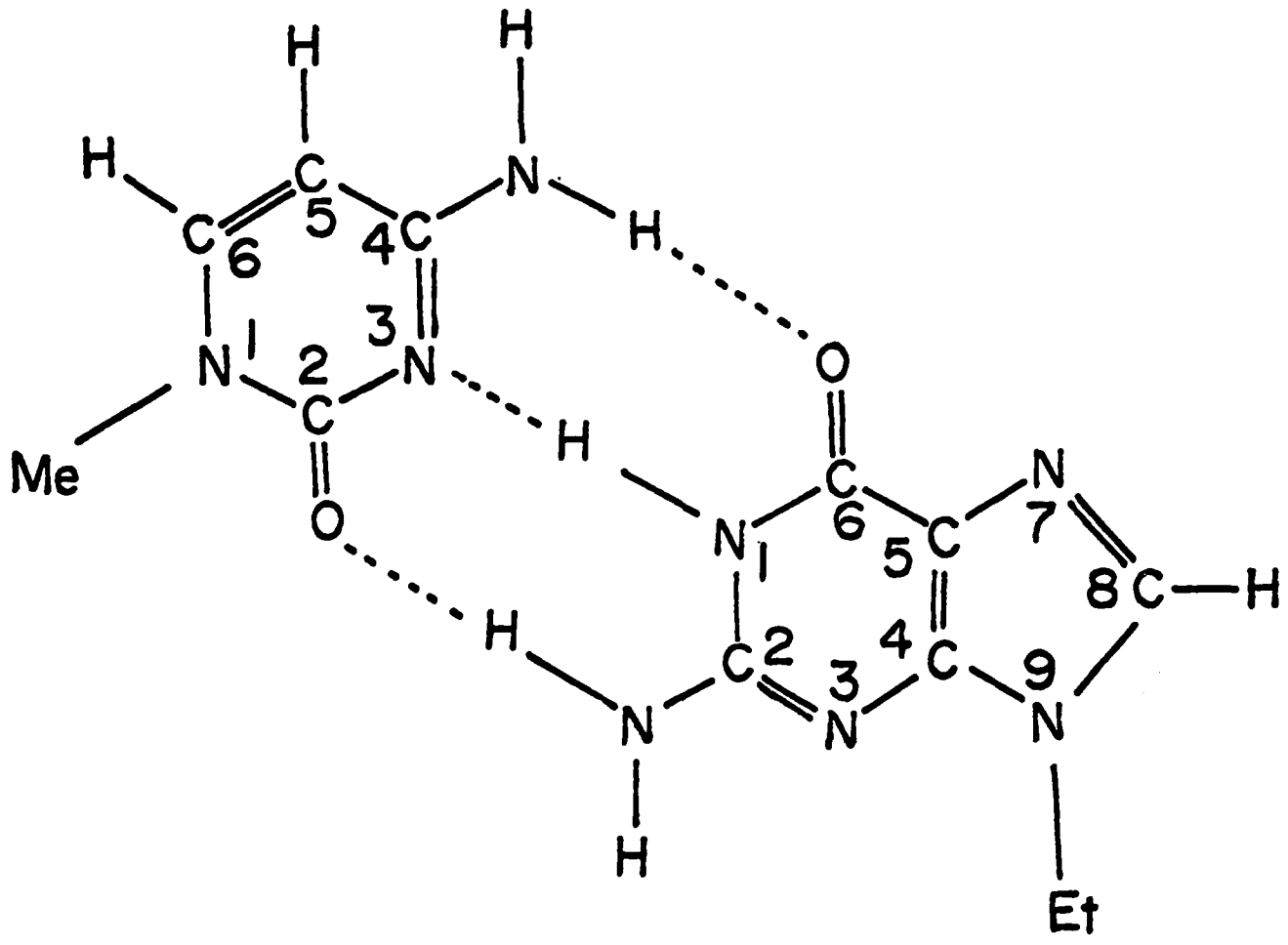
2. At a reduced temperature of $-5^{\circ}C$, the two amino protons in 1MC, one of which participates in a hydrogen bond and the other does not, have slightly different resonances. This was sufficient to establish that the hydrogen-bonded proton easily exchanges with the imino proton in 9EG, while the non-hydrogen-bonded proton exchanges only to a slight extent. This led to the conclusion that hydrogen bonding was a necessary condition for proton exchange.

3. The amino protons of 9EG do not exchange with other protons.

4. Proton exchange takes place between the imino proton of BrU and the amino proton of 9EA; furthermore, the exchange is more effective in chloroform than in DMSO. Since it is known that hydrogen bonds between solute molecules are formed more readily in chloroform than in DMSO, this observation provides further support to the conclusion that the proton exchange process requires hydrogen bonding.

5. The proton exchange rate for the 9EA-5BrU system at room temperature is 10 sec^{-1} which is estimated to be more than twice the rate for spin-lattice relaxation.

In their discussion of possible mechanisms, Iwahashi and Kyogoku conjecture that an amino proton of 1MC moves to the carbonyl group of 9EG at the same time that the imino proton of 9EG moves to the 3N position of 1MC, leaving the hydrogen-bonded dimer in the imino-enol tautomeric form. Such a double interchange of protons could, in principle, take place through a quantum-mechanical tunneling process, as has been discussed in the literature. The return to the normal form requires internal rearrangements within each member of the dimer, possibly after a dissociation of the hydrogen bonds. In this connection, it is observed, as has been noted previously, that the amino protons of 9EG, which are not involved in the formation of the imino-enol tautomer, do not exchange with other protons. This mechanism is not forced upon us by the experiment and, indeed, Iwahashi and Kyogoku gave brief consideration to another mechanism which invokes an intermediate protonated species.



1-methylcytosine

9-ethylguanine

Figure 1

HEMOGLOBIN RESEARCH IN JAPAN

Mitchel Weissbluth

INTRODUCTION

The study of heme proteins occupies a prominent position in Japanese biophysics, due in no small measure to the pioneering work and overall influence of M. Kotani, currently the president of Science University of Tokyo. Many of Kotani's former students are now located in various universities and institutes and have themselves become leaders of research groups. We shall focus attention on the biophysics of hemoglobin, a molecule regarded as the prototype of proteins whose reactions with ligands exhibit a cooperative effect with concomitant structural changes. The efforts to understand the complexities of this molecule is world-wide; this report, however, is confined to some of the important contributions by Japanese scientists, though mention of work done elsewhere is inevitable.

For background information, the reader may be referred to the lucid article by Perutz (1978) which summarizes the present state of knowledge and understanding of the properties of hemoglobin.

T AND R CONFORMATIONS

The hemoglobin molecule consists of four subunits, each of which contains a single polypeptide chain (the protein or globin part) and a heme (iron protoporphyrin IX). The chains are of two types–designated α and β–which differ primarily in the sequence and number of amino acid residues–141 in α and 146 in β. Each residue is labeled according to the segment of the chain to which it belongs and/or by its position in the chain, numbering from the amino end.

The quaternary structure of hemoglobin exists in (at least) two conformations known as T(tense) and R(relaxed), which are designations to describe two distinct spatial arrangements of the four subunits relative to one another. The T conformation is further characterized by several ionic linkages, or salt bridges, among the four subunits and by the presence of a phosphate such as 2,3-diphosphoglycerate (DPG) in the region between the two β subunits. In R, the salt bridges and the phosphate are absent. Hemoglobin A (HbA)–the normal human variety–in the deoxygenated state (deoxy HbA), i.e., with a vacancy in the sixth coordination position on each iron atom, is in the T conformation, while oxygenated hemoglobin A (oxy HbA), in which the sixth coordination position is occupied by an oxygen molecule, is in R. Thus, T has a low affinity for oxygen binding whereas R has a high affinity. There is a large body of evidence to suggest that a transition between the two conformations is essential for the occurrence of cooperative effects in the oxygen binding characteristic, also known as the saturation curve.

There are many mutant or abnormal hemoglobins which depart from the normal HbA in various structural and/or chemical features. Among the mutants are the two known as Hb Kansas and Hb M Milwaukee, in each of which a substitution of an amino acid residue has occurred in the β chains. In Hb Kansas, asparagine (ASN) 102 has been replaced by a threonine (THR), and in Hb M Milwaukee, valine (VAL) 67 has been replaced by a glutamic acid (GLU). Both of these mutant hemoglobins bind oxygen reversibly, but they show very little cooperativity; and, in the presence of inositol hexaphosphate (IHP), it has been demonstrated that the two mutants remain in the T conformation even when fully oxygenated, in contrast with oxy HbA. Hence, experimenters have at their disposal deoxygenated and oxygenated hemoglobins, both of which are in the low-affinity T conformation. Still other varieties of modified hemoglobins, useful for experimental purposes, are

obtained by removing the C (carboxyl)–terminal residues from the α chains or from both the α and β chains. Again, these modified hemoglobins bind oxygen reversibly but not cooperatively. Since the terminal residues participate in the inter-subunit salt bridges which are required for the stabilization of the T conformation, the absence of such residues results in the hemoglobin remaining in R even when it is completely deoxygenated, again in contrast to HbA. Thus, we now also have oxygenated and deoxygenated hemoglobins, both of which are in the high affinity R conformation.

In short, experimenters have at their disposal four types of hemoglobin: deoxy Hb A (T), deoxy modified Hb (R), oxy mutant (T) and oxy Hb A (R).

RESONANCE RAMAN SPECTRA

At the Institute for Protein Research, Osaka University, Suita, T. Kitagawa, M. Abe, and H. Ogoshi investigated several kinds of porphyrins by the method of resonant Raman scattering–a method that capitalizes on the fact that the intensity of Raman scattering is greatly enhanced when the wavelength of the excitation light is in the region of a vibronic band. The vibrations associated with the chromophore of the molecule appear as the resonance Raman lines. Hence it is necessary to assign the Raman lines to the individual vibrational modes before one can discuss the detailed relationship between a particular spectrum and the structure of the molecule. Kitagawa et al. (1978) measured the spectra of several porphyrin derivatives, classified the bands, and identified their symmetry species; in a companion paper, Abe et al. (1978) carried out a normal coordinate analysis. This work provided basic information for the assignment of resonance Raman lines of heme proteins and the characterization of vibronic interactions in metalloporphyrins.

Investigators were now in a position to use Raman resonance spectroscopy in attempts to answer specific questions concerning structural details of various kinds of hemoglobins. Such work was undertaken by K. Nagai, T. Kitagawa, and H. Morimoto at the Institute for Protein Research. Employing the 488 nm line from an argon ion laser as the source of excitation, they investigated the four types of hemoglobins mentioned at the end of the previous section. For the deoxy hemoglobins in both T and R, they found a Raman line at 298 ± 1 cm^{-1} which was identified with the stretching mode of Fe-N_ϵ where N_ϵ is the nitrogen on the imidazole ring associated with the proximal histidine F8; i.e., the histidine in the polypeptide chain to which the heme is covalently bonded. They also observed three totally symmetric porphyrin modes at 675, 364, and 342 cm^{-1}, the same for T and R. For the oxyhemoglobins, the Fe-O_2 stretching frequency was approximately 570 cm^{-1}, the same within 5 cm^{-1} for both T and R. They concluded that, although there were marked differences in the heme structure of oxy- and deoxy-hemoglobins, transitions between T and R conformations, under conditions where the ligands remained the same, produced little if any change in the heme structure.

Such results might have been expected at first sight since, after all, T and R refer to the quaternary structure, and there is no reason, *a priori*, for the hemes to be affected in a transition between the two conformations. However, it is also known that the free energy of oxygen binding in R is about 3 kcal/mol larger than in T. If this energy were localized in a single bond as, for example, Fe-N, Nagai et al. estimate that it would have been observable by their Raman resonance method and would therefore have given an indication of a structural change in the heme in the course of a T-R transition. Since the Raman spectra in T and R were essentially the same, provided the ligands were not altered, it is concluded that the energy difference of 3 kcal/mol is not localized in the heme.

The detailed nature of the iron-oxygen bond and the closely related question concerning the origin of the diamagnetism in oxyhemoglobin have been subjects of considerable discussion in the literature. Thus, it is known that deoxy Hb is paramagnetic ($S = 2$), and the oxygen molecule in the ground state is also paramagnetic ($S = 1$), but oxy Hb is diamagnetic ($S = 0$) in apparent violation of any simple-minded scheme for the coupling of angular momenta. The resonance Raman work of Kitagawa and colleagues is relevant here, too. Their investigations included a classification of the observed Raman spectra of several kinds of hemoglobins and myoglobins, the latter being single subunit heme proteins with heme structures identical to those in hemoglobin. Three types of spectra, designated B, C, and D, were observed. Deoxyhemoglobin and deoxymyoglobin, both of which are high

spin (S = 2) ferrous compounds, produced type B spectra; hemoglobin and myoglobin fluoride, as well as the acid-met derivatives which are all high spin (S = 5/2) ferric, belonged to type D. However, type C spectra were associated with both low spin (S = 0) ferrous compounds including oxyhemoglobin and carbon monoxyhemoglobin, and several low spin (S = ½) ferric derivatives, among them the cyanide, azide, and imidazole.

The similarity in the Raman spectra of both low spin (S = 0) ferrous and low spin (S = ½) ferric hemoglobin and myoglobin is consistent with other observations on these compounds, as, for example, in Mössbauer spectroscopy (see below) and has led to the hypothesis that the binding of oxygen to hemoglobin and myoglobin is not of the form $Fe^{2+} - O_2$ but rather $Fe^{3+} - O_2^-$. On the latter hypothesis the diamagnetism of oxy Hb and oxy Mb arises from the coupling of Fe^{3+}(S = ½) with O_2^- (S = ½) to give a net spin of zero.

According to Kitagawa, the electronic aspects of ligand binding in the low spin ferrous and ferric compounds are not the same despite the similarity of their Raman spectra. The difference can be seen in the distribution of electrons in the two cases. In Fe^{3+}, the five d-electrons are distributed in accordance with $(d_{xy})^2$ $(d_\pi)^3$ $(d_{z^2})^0$ $(d_{x^2-y^2})^0$ where d_π is the degenerate orbital consisting of d_{xz} and d_{yz}. Ligand binding arises as a result of lone pair electrons of the ligand coordinating with the vacant d_{z^2} orbital of iron. In Fe^{2+} the distribution of the six d-electrons is described by $(d_{xy})^2$ $(d_\pi)^4$ $(d_{z^2})^0$ $(d_{x^2-y^2})^0$ and the triplet ground state of O_2 by $(2p\pi_g)^2$. The binding of oxygen to iron comes about from a delocalization of an electron from d_π of Fe to $2p\pi_g$ of O_2, leaving three electrons in d_π as in the ferric case. The three d_π electrons enter into π-bonds with orbitals of the porphyrin ring. Since this feature is the same in both the ferric and ferrous case, Kitagawa does not find it surprising that the Raman spectra are similar.

THERMODYNAMIC MODELS

The model of hemoglobin based on two conformations is a specific example of the more general two-state allosteric model of Monod, Wyman, and Changeux (MWC). For the hemoglobin case, T and R are assumed to be in equilibrium and are characterized by oxygen association constants K_T and K_R, respectively. The mathematical formulation of the MWC model, assuming the four subunits are equivalent insofar as oxygen binding is concerned, leads to a simple expression for the oxygen saturation function in terms of K_T/K_R and a constant L, the equilibrium constant between T and R in the absence of oxygen.

One may now conceptualize the cooperativity of hemoglobin on the basis of the MWC model. In the absence of oxygen, T–the low affinity conformation–is predominant, i.e., the population in T is much higher than in R. As the partial pressure of oxygen rises, oxygen binding to a hemoglobin molecule in T triggers a transition from T to R, the latter being the high-affinity conformation. Thus the affinity for oxygen binding at a later stage of oxygenation is greatly increased compared to the affinity at an early stage–which is the essential feature of cooperativity.

Quite naturally, one would like to know what experimental evidence there is to support the two-conformation model of hemoglobin. An obvious approach is to determine how well the theoretical oxygen saturation function containing the parameters K_T, K_R, and L can be made to fit the oxygen saturation curves obtained experimentally under a variety of conditions. Though the method was obvious, a proper test required the prior development of rapid, automatic oxygenation apparatus permitting accurate measurement of saturation over the range 0.01 to 0.99. This was accomplished by K. Imai (Department of Physicochemical Physiology, Medical School, Osaka University, Osaka) and his coworkers. Over the past several years they have been studying the thermodynamics of hemoglobin oxygenation (Tyuma et al., 1971 a,b; Imai, 1973; Imai and Tyuma, 1973; Tyuma et al., 1973 a,b; Imai, 1974; Imai and Yonetani, 1975 a,b). A report of some of their more recent work was recently presented by Imai (1978). The main results and conclusions are the following:

1. Accurate oxygen binding curves of HbA were obtained at temperatures between 10° and 35°C, at pH 6.5-9.1, in the presence and absence of 0.1 M Cl^-, 2 mM DPG or 2 mM IHP.

2. K_T, K_R, and L were evaluated from the binding curves. It was found that the two-state allosteric model

(MWC) can describe a single binding curve for a given condition but cannot simultaneously describe a set of curves which are determined under different conditions. This conclusion is not altered by taking into account the functional inequivalence of T and R subunits.

3. Assuming that oxygen binding occurs sequentially (Adair hypothesis) according to the reactions

$$Hb(O_2)_{i-1} + O_2 \rightleftharpoons Hb(O_2)_i \qquad i = 1,2,3,4$$

it was found that in most cases $k_1 \lesssim k_2 \lesssim k_3 \ll k_4$; that is, k_1, k_2, and k_3 were of comparable magnitude but much smaller than k_4. Also, under some conditions, as in the presence of 2 mM DPG, it was observed that $k_2 > k_3$.

Formally, it is possible to rationalize at least some of the results by the adoption of a three-conformation model. One hypothesizes the existence of a new conformation S which has a lower affinity for oxygen binding than T and R. This introduces into the saturation function an additional oxygen association constant K_s and an equilibrium constant M = S/R between R and S conformations in the absence of oxygen. Although such a scheme does describe the various oxygen binding curves, the difficulty is to interpret the new state S since no such state is observable in the x-ray diffraction studies. Moreover, such a model does not provide an explanation for the relation $k_2 > k_3$ obtained in some of the experimental data.

One suggestion made by the authors is that it might be fruitful to distinguish between structural conformations and so-called affinity states. According to this view, the picture of two structural conformations, T and R, is retained but the affinity for oxygen binding in each conformation is not unique. Instead, it is assumed that the oxygen affinity in the T conformation is continuously distributed over a wide range of free energies, whereas in R the range is narrower. Precisely what is meant by an affinity state is not explained, and it was left to another group under the direction of J. Otsuka (Department of Applied Biological Science, Science University of Tokyo, Noda) to attempt a clarification of the concept at the molecular level.

MOLECULAR ASPECTS OF COOPERATIVITY

Perutz was the first to provide a molecular picture of a T ↔ R transition. He assumed that the binding of oxygen by any one subunit in T is accompanied by the rupture of the salt bridges formed by that subunit with its neighbors. That is, the rupture of the salt bridges of the oxygenated subunit occurs at every stage of oxygenation. Further, the rupture of each salt bridge removes one of the constraints holding the molecule in the T conformation and shifts the equilibrium toward R.

The Perutz picture was amended by Otsuka and his colleagues. In a series of papers (Arata and Otsuka, 1975; Otsuka and Kunisawa, 1977; Otsuka and Kunisawa, 1978; and Kunisawa and Otsuka, 1978), they call attention to the importance of the van der Waals contacts between subunits. Their calculations indicate that the contact energy is of comparable magnitude to the salt bridges. It is these contacts that provide a molecular interpretation for the affinity states discussed previously. In their view, there are still two structural (quaternary) conformations, i.e., under normal conditions, deoxy Hb is in T and oxy Hb in R. But within each quaternary conformation there is a continuum of states that differ from one another in the details of the contacts between subunits. Changes in pH, addition of phosphates or anions produce subtle changes in the contact region which manifest themselves in changes in the oxygen affinity.

The steps involved in the oxygenation process are now being visualized as follows: In the T conformation, oxygenation of a subunit induces a strain in the contact region of that subunit with its neighbors. More specifically, the strain energy due to oxygenation in the early stages is assumed to be stored in the contacts between HC and C segments and the origin of the relation $k_2 > k_3$ is attributed to the strength of the contacts. At a later stage of oxygenation, the salt bridges can no longer maintain the integrity of the T conformation against the strain in the contact regions. The salt bridges rupture, the subunits rearrange themselves in the R conformation, and a new set of van der Waals contacts is formed. The new contacts serve a dual purpose: they

stabilize the R conformation and they cause the fourth Adair constant k_4 to be much larger than the first three.

Thus the interfaces between subunits and the degree of strain stored in them are endowed with a major role in controlling the cooperativity of oxygen binding, and it is in this respect that Otsuka's approach departs from that of Perutz, who puts primary emphasis on the salt bridges.

MÖSSBAUER RESONANCE

In Mössbauer spectroscopy, the source consists of radioactive nuclei which emit γ-rays in the course of radioactive decay from an excited state to the ground state. By embedding the nuclei in a solid matrix, energy losses due to recoil are suppressed and the γ-ray line width becomes very narrow. The energy of the γ-ray line may be Doppler-shifted by means of a velocity modulator. When such γ-rays are incident upon a sample containing the same nuclei as the source, but in their ground state, resonant absorption may occur and the resulting spectrum reflects various hyperfine interactions of the nuclei with the local environment. In heme proteins the relevant nuclei are ^{57}Fe whose nonvanishing quadrupole moment can interact with an electric field gradient (EFG) to produce a doublet in the absorption spectrum. The EFG is a tensor quantity with principal components V_{xx}, V_{yy}, and V_{zz}.

In the most common form of Mössbauer spectroscopy of heme proteins, the samples are in the form of polycrystalline powders or frozen solutions. In that case, one observes the average interaction of the nuclear quadrupole moment with the components of the electric field gradient tensor. But in a single crystal, the intensity ratio of the two lines comprising the quadrupole doublet depends on the angle between the propagation direction of the γ-rays and the principal axis system of the EFG tensor. Measurements of line intensities at various crystal orientations provide considerably more detailed information concerning the quadrupole interaction. A group under Y. Maeda at the Research Reactor Institute, Kyoto University, Osaka, succeeded in growing single crystals of myoglobin enriched with ^{57}Fe and of sufficiently good quality to conduct Mössbauer experiments. The crystals contain two hemes per unit cell with different orientations of the heme planes with respect to the crystal axes; it was therefore necessary to apply external magnetic fields to achieve an unambiguous analysis of the spectra.

In the context of the present discussion, the most important result emerging from this work is the striking similarity in respect to Mössbauer absorption between myoglobin azide, a low spin (S = ½) ferric compound, and oxymyoglobin, a low spin (S = 0) ferrous compound. In both cases, the quadrupole splitting is large–about 2.1 mm/sec–and the largest component of the EFG tensor, V_{zz} (by convention) lies nearly in the heme plane. Other Mössbauer parameters are also similar so that here, too, the superoxide hypothesis for the binding of oxygen to iron ($Fe^{3+} - O_2^-$) receives strong support, though other interpretations, e.g., a triplet-triplet interaction, are not automatically ruled out. In sharp contrast to the behavior of oxy Hb, carbonmonoxyhemoglobin, which is also a low spin ferrous compound, has a very small quadrupole splitting and V_{zz} is nearly perpendicular to the heme plane.

MAGNETIC CIRCULAR DICHROISM

When circularly polarized light impinges on a substance containing molecules with asymmetric structures, the absorption coefficient for left circularly polarized light (ϵ_l) may differ from that for right circularly polarized light (ϵ_r). The difference, $\Delta\epsilon = \epsilon_l - \epsilon_r$, is a measure of the circular dichroism. Such an effect may be induced in a wider range of substances by a longitudinal magnetic field, i.e., a field parallel (or antiparallel) to the propagation direction of the light, in which case the effect is known as magnetic circular dichroism (MCD). Ordinary absorption depends, in most cases, only on the electric dipole moment while MCD depends on both the electric and magnetic dipole moments; hence MCD can often be helpful in the analysis of absorption spectra containing unresolved components. In the case of heme proteins, MCD spectra are sensitive to the oxidation and spin states of the heme iron and are useful in exploring the electronic structure of the heme and its vicinity, including the axial ligands.

MCD line shapes are classified as type A, B, or C. They type A line shape is typically associated with

transitions from a non-degenerate ground state to an excited state whose degeneracy, due to a nonvanishing angular momentum, has been split by the applied magnetic field. Transitions from a magnetically-split ground state to a non-degenerate excited state produce a line shape of type C; and, finally, if the magnetic field mixes the ground and excited states with other electronic states, the line shape is of type B.

An active group in this field is led by M. Hatano at the Chemical Research Institute of Non-aqueous Solutions, Tōhoku University, Sendai. They have developed instrumentation which enables them to obtain MCD spectra from the visible to the infrared region extending to 2000 nm. Their interests are far-ranging and include various myoglobin derivatives for which they obtained MCD spectra in the near infrared region (Yoshida et al., 1975; Kobayashi, 1975; Nozawa et al., 1976; Shimizu et al., 1976 a,b; Hatano and Nozawa, 1978). In this region, there are no porphyrin transitions; hence, the observed bands are associated with charge transfer transitions from porphyrin π orbitals to the iron d_π orbitals, or the d – d transitions of the heme iron.

In the case of ferric myoglobin, low and high spin, the MCD spectra reinforced the identification of the infrared band as a charge transfer transition from porphyrin π to iron d_π orbitals. Oxymyoglobin has some MCD bands in the region 700-1000 nm, but what is perhaps of greater significance is that there is no resemblance between the oxymyoglobin MCD spectrum and that of any of the ferric derivatives, low or high spin, in contrast to the observations in resonance Raman and Mössbauer spectroscopy. Hence MCD spectroscopy in the infrared does not support the bonding scheme $Fe^{3+} - O_2^-$ for oxymyoglobin. Without doubt, the iron-oxygen bond is sufficiently subtle to warrant further study.

THEORETICAL TREATMENT OF THE HEME–O_2 SYSTEM

In addition to the experimental work bearing on the iron-oxygen interaction in hemoglobin and myoglobin, an attempt was made by Otsuka and his colleagues to treat the system theoretically (Seno et al., 1972; Otsuka et al., 1973; Seno et al., 1976; Otsuka et al., 1977). Their approach was semi-empirical in the sense that the electronic states of iron (in the heme) and of the oxygen molecule were evaluated empirically, but the interaction between the two was calculated non-empirically by the Heitler-London method. The justification for this approach stems from the fact that the interaction energy is much smaller than the total energy of the system, so that the electronic states are not greatly perturbed by the interaction. The choice of the Heitler-London method over the currently more popular molecular orbital method was essentially a compromise between tractability and accuracy.

The questions they set out to answer were (1) which unperturbed states are the main contributors to the binding of oxygen to heme; (2) what are the relative contributions of the ionic structures $Fe^{2+} - O_2$, $Fe^{3+} - O_2^-$, and $Fe^{+} - O_2^+$; and (3) is the oxygen molecule bound with the O – O axis parallel to the heme plane (Griffith model) or inclined at 60° to the normal of the heme (Pauling model)?

The calculations indicate that, upon binding an oxygen molecule, the splitting parameter in the d-orbitals alters its value to cause the electronic state-of-the-heme to change from a quintet (S=2) – the normal state for deoxy Hb (or Mb) – to a triplet (^3E) or a singlet ($^1A_1$). With the O – O axis parallel to the heme, the lowest state is mainly triplet-triplet, i.e., $Fe^{2+}(^3E) - O_2(^3\Sigma_g^-)$. In the inclined arrangement, the lowest state consists of a mixture of ionic structures and spin states, the dominant ones being the triplet-triplet $Fe^{2+}(^3E) - O_2(^3\Sigma_g^-)$, singlet-singlet $Fe^{2+}(^1A_1) - O_2(^1\Delta_g)$, and the charge transfer $Fe^{3+}(^2E) - O_2^-(^2\Pi_g)$. When the lowest energy eigenvalue is calculated for the two arrangements–parallel and inclined–it turns out that they are nearly equal and the question of the bonding arrangement remains undecided.

A complete *ab-initio* molecular orbital calculation of an iron porphyrin with axial ligands remains as a goal pursued by various investigators. K. Ohno and his group at Hokkaido University in Sapporo are in the forefront of this work, a description of which is contained in Vol. 3, No. 4, of this *Bulletin*.

A theoretical development of another kind is being pursued by S. Mizuhashi of the Department of Applied Science, University of Electro-Communications, Tokyo. His objective is to identify the primary mechanism that

triggers the events ultimately leading to the conformational change associated with deoxygenation. Mizuhashi's focus is on the position of the iron atom, which, in deoxy Hb, is situated about 0.6Å above the heme plane, whereas in oxy Hb, the iron is in the plane. These movements are transmitted to the contacts between subunits and promote the conformational transition.

Is there a physical mechanism that urges the iron atom to undergo such displacements? The answer given by Mizuhashi (1977, 1978) is that a pseudo-Jahn-Teller effect could be the operative mechanism. According to the Jahn-Teller theorem, a (nonlinear) symmetric molecule in a degenerate electronic state tends to distort, under the influence of a vibrational coupling, so as to reduce the symmetry and remove the degeneracy. In the application to hemoglobin, if the electronic states of iron in the heme are all based on 3d-orbitals, which are of even parity, the only allowed couplings are those with even vibrational modes. In that case the ligands can distort, but the central iron atom remains in its original position. Mizuhashi supplemented the 3d-orbitals of iron with 4s and 4p; he then showed that the inclusion of the 4p orbitals, which are of odd parity, leads to electronic states which can couple with an odd vibrational mode of the species a_{2u} (in D_{4h}). This leads to a distortion—the pseudo Jahn-Teller effect—in which the iron and axial nitrogen atoms displace in a direction perpendicular to the heme plane while all the other atoms bend in the opposite direction.

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Names and Addresses of Principal Investigators Mentioned in this Article

M. Abe
Shoin Women's University
Nakajimadori, Fukiaiku
Kobe, Japan 651

M. Hatano
Chemical Research Institute of
Non-aqueous Solutions
Tohoku University
Sendai, Japan 980

K. Imai
Department of Physicochemical Physiology
Medical School
Osaka University
Osaka, Japan 530

T. Kitagawa
Institute for Protein Research
Osaka University
Suita, Osaka, Japan 565

Y. Maeda
Research Reactor Institute
Kyoto University
Noda, Kumadoricho, Sennan-gun
Osaka, Japan 590-04

S. Mizuhashi
Applied Science Department
The University of Electro-Communications
Tokyo, Japan 182

H. Morimoto
Department of Biophysics
Osaka University
Toyonaka, Japan 560

K. Nagai
The Second Department of Physiology
Nara Medical College
Kashihara, Nara, Japan 634

H. Ogoshi
Department of Synthetic Chemistry
Kyoto University
Yoshida, Sakyo-ku
Kyoto, Japan 606

J. Otsuka
Department of Applied Biological Science
Tokyo Science University
Noda, Chiba, Japan 278

CURRENT TOPICS IN RADIOLOGY: THE INTERNATIONAL CONGRESS OF RADIATION RESEARCH

George N. Catravas and Joseph F. Weiss

The International Congress of Radiation Research (ICRR) is held every three years under the sponsorship of the International Association for Radiation Research. This year the ICRR was held 13-19 May 1979, in Tokyo, Japan, under the auspices of the Science Council of Japan and the Japanese Association for Radiation Research.[1] President of the congress was Dr. K. Misono of the Japan Atomic Energy Commission, Tokyo. The program committee was headed by Dr. T. Terasima of the National Institute of Radiological Sciences in Chiba.

The congress attracted some 1500 scientists from 46 countries, with the United States and Japan being represented by the largest number of participants. The People's Republic of China was also represented, for the first time, with a 15-member delegation. In addition to the main congress, several satellite symposia were held which gave opportunities for indepth analysis of specific problems. Particularly noteworthy were a symposium held in Kyoto related to the repair of chromosomal damage after irradiation, and a symposium on late effects of radiation held in Hiroshima. Presented papers followed the interests of the members of the participating radiation societies, which are comprised mainly of physicists, chemists, biologists, and medical scientists. We will attempt to give an overview of what was discussed in the mammalian radiobiology field. Emphasis will be placed on those areas that appeared to generate a large amount of interest: radiotherapy, radiation carcinogenesis, and radiation effects on biologically important macromolecules and cells related to the immune response.

CARCINOGENESIS AND OTHER LATE RADIATION EFFECTS

A plenary lecture delivered by Dr. Stewart C. Finch of the Radiation Effects Research Foundation (RERF), Hiroshima, covered and evaluated the late radiation effects in atomic bomb survivors. The most important radiation effect has been the increased occurrence of certain malignancies, mainly leukemia and cancers of the thyroid, breast, and lung. Leukemia among survivors has been the most notable sequela of ionizing radiation of the atomic bombings in Japan. Although the peak of leukemia prevalence in Hiroshima survivors apparently passed by 1961, a marked increase in chronic granulocytic leukemia was observed among proximally exposed survivors, especially in Hiroshima. This may have resulted from the relatively greater neutron component of the Hiroshima A-bomb as compared to that of Nagasaki.

Other late radiation effects found in the atomic bomb survivors are the increased occurrence of lenticular opacities, lymphocyte chromosomal aberrations, and retardation of growth and development following exposure in early life.

A special session of the congress dealt with the noncarcinogenic late effects of ionizing radiation. These include diminished intelligence and retardation of growth and development following fetal irradiation. Some effects such as cataract formation appear to require a radiation dose in excess of a "threshold," while others, such as teratogenic effects, appear to increase as a function of dose without a threshold. Of greater biologic interest are the effects of relatively low doses of radiation on longevity and the frequency of disease. Although definite proof is lacking, available evidence indicates that radiation does not accelerate natural aging in man or produce life-threatening diseases. Its life-shortening effect is exerted mainly through carcinogenesis, which appears

[1] A brief description of this meeting and a list of symposium subjects may be found in "Sixth International Congress of Radiation Research" by Mitchel Weissbluth, Vol. 4, No. 2 of this *Bulletin*.

to be a specific effect of ionizing radiation. Sessions at the congress considered hazards and risk assessments of low doses of diagnostic radiation, which will certainly be a continuing debate in the coming years.

RADIATION EFFECTS ON THE IMMUNE SYSTEM

The effects of ionizing radiation on the immune system of the organism have been extensively investigated. Immunologic responses serve three major functions: defense against infections, immunologic homeostasis, and immunologic surveillance against development of malignancy. It is known that exposure to ionizing radiation results in impairment of the function of the immune system of the organism; therefore, the consequences of the malfunction of the immune system are expected to be manifold. Research efforts have been directed into finding means to counteract the radiation-induced immunosuppression, and various immunostimulants have been tested with more or less promising results.

Radiation-induced immunosuppression is the result of the extreme radiosensitivity of hemopoietic tissues and circulating white cells such as lymphocytes. The effects of ionizing radiation on the hemopoietic system were also discussed in a number of papers presented during the congress. From recent studies it has become evident that the hemopoietic renewal system represents the daily production of an enormous number of cells in the bone marrow and that this production can be increased upon demand. The part of the cell-renewal system responsible for maintenance of cell production in response to demand is the stem cell pool. Special emphasis has been given to the effects of ionizing radiation on the stem cell pool and the role that circulating stem cells play in regeneration of the hemopoietic system after exposure to ionizing radiation.

RADIATION EFFECTS ON BIOMOLECULES AND MEMBRANES

Many papers were concerned with the elucidation of mechanisms underlying radiation-induced changes in biologically important macromolecular constituents of the cell, such as nucleic acids, proteins, enzymes, and cellular membrane components. Chromosomal breakage and aberrations in lymphocytes of mammalian organisms exposed to ionizing radiation have been investigated in part to determine whether a radiation dose-response exists that could lead to the development of a biologic radiation dosimeter. Several studies were presented in which the production of free radicals in irradiated biomolecules was investigated. Formation of free radicals, which takes place almost instantaneously (10^{-16} to 10^{-14} seconds following irradiation), is due to the strong oxidizing characteristics of ionizing radiation and constitutes what is termed as a "primary radiochemical event." This is followed by the formation of "biochemical lesions," which will lead to the formation of visible radiation lesions and possible death of the organism.

Much emphasis has been given to research on the mechanism underlying repair, especially of radiation-induced breaks and single-strand lesions in the DNA molecule. The DNA repair process was found to occur in the "linker" regions of chromatin and also in the nucleosomal core DNA which, however, seems to be repaired at a slower rate. Evidence was also presented indicating that, in mammalians cells, DNA synthesis repair might be the function of the specific enzyme DNA polymerase-β. More extensive studies on repair mechanisms of radiation-induced DNA lesions have been conducted using bacteria and yeasts since they are much easier and simpler systems to study than mammalian cell DNA.

The effects of ionizing radiation on components of biologic membranes are also of much current interest. Cellular membranes are made up of a lipid bilayer in which protein and enzyme molecules are embedded. They play a very essential role in cellular function; therefore, any changes in their dynamic or structural characteristics induced by toxic agents, such as ionizing radiation, may result in profound physiological and biochemical disturbances inside the living cell with resultant damage and possible death of the cell. Research presented during the congress indicates that, in addition to other damage to cellular membranes such as lipid peroxidation, ionizing radiation induces marked changes in membrane fluidity (microviscosity) and alterations in membrane protein-lipid interactions.

RADIOTHERAPY, RADIOSENSITIZATION, AND RADIOPROTECTION

Experimental radiotherapy studies have been performed using either tumors transplated in experimental animals or cells in tissue culture. In much of this research, various qualities of radiation were tested alone or in combination with chemotherapy. The effect of hyperthermia (preferential killing of malignant cells by heating), alone or in combination with radiotherapy and chemotherapy, also is being studied extensively. Focused microwave irradiations for producing localized hyperthermia are being used increasingly with quite promising results. Another area of intense investigation is the use of hypoxic cell sensitizers—chemicals that assist in killing residual oxygen-dependent malignant cells, which are resistant to radiation alone. Combination of radiosensitizers with hyperthermia and radiotherapy has shown that radiosensitizers enhance the response of tumor cells to radiation or hyperthermia.

Studies on the use of chemicals to protect normal cells from damage during radiotherapy have also been reported. This field of research has, however, much broader applications in the protection of the mammalian organism from the effects of radiation. Drugs with antioxidant properties have been used for this purpose with some promising results. The combined effects of radioprotective drugs, radiosensitizers, and radiotherapy on tumor growth have also been investigated. It is extremely interesting to hear about unusual experimental studies that will possibly find clinical applications within a few years.

A VISIT TO THE TOKYO METROPOLITAN INSTITUTE

Thomas Harrington

Recently I had the pleasure of spending three months doing research with the Department of Neurophysiology at the Tokyo Metropolitan Institute for Neurosciences, a research facility supported by the city of Tokyo to provide both theoretical and clinical understanding of the human nervous system's mechanisms and of its disorders. The Institute, housed in a sizeable multi-story building located at 2-6 Musashi-dai, Fuchu, Tokyo 183, is an interesting amalgamation of many branches of science. There are coordinated but distinctly separate departments of genetics, neurochemistry, epidemiology, psychology, microbiology, behavioral physiology, neurobiology, medical chemistry, anatomy and embryology, neurophysiology, neuropathology, clinical neuropathology, rehabilitation, and social sciences.

During my stay I had contact with a number of interesting lines of research. Following are brief descriptions of a few which are currently being pursued in the department of neurophysiology. (My exposure, and hence my reporting, have been largely biased and modulated by my own daily routines at the Institute; therefore my varying depth of coverage of the separate experiments does not necessarily reflect their respective importance nor the amounts of effort being invested in them.)

Dr. Masayasu Sato, Director of the Institute, is actively continuing his research in taste reception. Dr. Sato and his team are presently focusing on the mysteries of "sweet" reception from three separate vantage points: behavioral, neurophysiological, and biochemical. The parallel behavioral and neurophysiological investigations are being carried out in the taste system of a mole-like animal selected because of its similarity to humans in this facet of taste. Basically neural responses are recorded and compared to behavioral responses in order to unravel the neural code by which the neurons of the tongue communicate with the brain. The biochemical investigations are being carried out on the taste-related organs of the skin from monkey tongue. The tongue epithelium is removed and divided into fractions which are analyzed biochemically for the sucrose- and sacchrin-binding proteins that are suspected to operate as the initial step in sweet taste perception. The objective is two-fold. First, Dr. Sato wants to know where in the structures of the tongue the crucial molecules are found, and second to identify them.

Dr. Muneo Shimamura, Chairman of the Neurophysiology Department, is presently continuing his pioneering work on the sensorimotor reflex systems of the spinal cord. The current emphasis is on the spino-bulbo-spinal system, a neural entity activated primarily by excitation of cutaneous nerves or by stimulation of the skin. In this reflex loop, neural signals ascend the spinal cord to a location in the brain stem known to have an effect on the general tone of muscle movement. These signals reflexively return, mainly to motor neurons that activate muscles that flex rather than extend the limbs, at various levels of the spinal cord, affecting and coordinating reflexes between limbs. By stimulating at a series of selected locations on the skin and in the spinal cord and then recording neural responses at other selected locations under a variety of conditions, such as cutting or cooling, that selectively isolate different parts of the reflex, Dr. Shimamura and those who have worked with him have managed to localize and trace the tangled circuitry of the reflex and separate it from other reflex systems of the spinal cord.

Dr. Shimamura has also investigated behavioral phenomena that may be served by this reflex, previously studying the startle reflex in people in whom it was accented by cerebral palsy, and very recently by correlating its characteristics with breathing cycles. This latter work was suggested by the fact that stimulation to the skin of

a human can produce different amounts and qualities of sensation depending upon whether it is delivered while the observer is breathing in or breathing out. Dr. Shimamura has evidence that seems to implicate the reflex mechanism in this perceptual phenomenon.

Dr. Shimamura is also continuing his collaboration with Dr. Mari Hiraoka, an ophthalmologist, adding to their previous findings about the neural underpinnings of ocular mechanisms such as the blinking reflex.

Dr. Hideo Sakata and his associate, Mr. Hidetoshi Shibutani, are investigating single cell responses in the parietal area of the cortex. First, a monkey is trained to regulate its eye movements precisely by fixating a light that may be moving or stationary. Then, as training proceeds, electro-oculogram electrodes are implanted to allow eye movements to be computer-monitored. A microelectrode recording chamber is also implanted and an apparatus for controlling and analyzing head movements is installed. Then recording sessions begin and the activities of single cells are noted as a wide variety of stimuli are presented. The cell responses are as highly varied as the stimuli to which they respond. Dr. Sakata is primarily interested in classifying responses to gaze fixation, to smooth tracking and to saccadic or glancing eye movements. There are cells in this region of the brain which respond selectively to each of these types of movement, often in only a fairly specific direction. Sometimes, and for certain classes, cells respond in the darkness implying an involvement of behavior systems such as eye positioning or volitional mechanisms. Other similar cells will respond only with the lights on, exhibiting a complete dependence on actual visual stimulation with light. Dr. Sakata has found some cells that appear to be location-specific, for example, that respond only when an object is located near the monkey and toward the upper right of its visual field. He has also discovered a type of neuron that responds as though it may be related to the perceptual phenomenon of induced movement where a human in the dark, viewing a small lighted object surrounded by a larger square, will perceive the object as moving if the square is moved, even though the lighted object remains stationary.

Dr. Hiroyuki Koike, working with a double-barreled capillary technique that he has developed, is following the movements of chemicals that are important to nerve functioning as they are transported along inside single nerve fibers. Initially he uses his double-barreled one- to two-micron diameter pipette to inject a minute amount of the chemical of interest, which has been radioactively tagged, into the cell and simultaneously he records the small voltage of the cell to insure that the chemical is actually being delivered properly and to be sure that the cell is not damaged. The cell is then kept alive for a matter of hours to allow the chemical under study to move out of the cell body and down the nerve fiber. Finally Dr. Koike determines the distribution of the chemical along the fiber. He slices the nerve containing the fiber into one-millimeter segments, homogenizing each individual segment and shaking it overnight. Then he examines the homogenized segments for radioactivity with a scintillation counter, determining how much of his test chemical had reached each location along the fiber during the time that the cell was alive. Alternatively, Dr. Koike uses autoradiography to measure movements of certain larger molecules. With this method, he places parts or sections of nerve onto photographic film for about one month; the radioactively-tagged chemical exposes the film in places where it has migrated and then the film is developed and examined at high magnification. This method, although failing with certain molecules such as acetylcholine, is more sensitive and can be used to determine which of the tiny structures in the nerve cell received, stored, or metabolized the chemical of interest.

In Dr. Noriichi Mano's laboratory monkeys are trained to perform motor tasks that involve specific voluntary movements. Dr. Mano then studies the relation of Purkinje cell activity to these movements and infers the underlying mechanisms of volition.

Drs. Tomoiichi Ohshima and Kazuhisa Ezure are examining the relation between synaptic activity, when nerve cells communicate among themselves, and arousal or quickening of the EEG, an electrical signal from the brain that varies with states of attention, waking, sleeping, and dreaming. They insert electrodes into appropriate cells and correlate synaptic activity with various forms of stimulation such as sound or actual electrical current to the brain.

In the laboratory of Dr. Nobufumi Kawai, experiments are being carried out to determine the effects of

different chemicals on the transmission of neural information within the nervous systems of lower animals, for example the crustaceans. This work is an extension of a long series of experiments by Dr. Kawai and his co-workers. These included work on hyperpolarization of excitatory nerve terminals by stimulating inhibitory nerves in the lobster. It also included isolation of chemicals that are found in hornet venom and the subsequent determination of their effects on communications between nerves and muscles of crustaceans. Also leading to the current work were studies of the effects of black-widow venom and of LSD.

As I previously noted, my coverage of the experiments continuing in the Institute's Department of Neurophysiology does not necessarily constitute a fair sampling. I have sadly slighted several outstanding investigators because my routines failed to put me in substantial contact with their work. Apologies are due to those whose investigations I did not cover, or covered too briefly.

THE JAPAN FOUNDATION

H. J. Walker

Newspapers in Japan frequently carry articles, guest editorials, and letters to the editor that are critical of Japan and the Japanese, many by Japanese authors. One of the most common themes of these special pieces concerns the image of Japan abroad and how to improve it. This concern is suggested in such statements as the following, which appeared in *The Japan Times*, an English-language daily newspaper published in Tokyo, between June 28 and August 19, 1979:

1. "Coverage of the United States by the Japanese press far exceeds the coverage of Japan by the U.S. press,"
2. "England spends 10 to 15 times more than Japan does on spreading knowledge of its culture around the world,"
3. "Europeans have been slow to form correct or timely images of Japan,"
4. "The popular image of Japan is still based very largely on perceptions which were formed during the 19th Century,"
5. "Japan seems more interested in learning about the outside world than in making itself known abroad,"
6. "At the moment, the government is doing practically nothing to convey important developments to the outside world," and
7. "Japan is a faraway, difficult-to-understand country."

It is just such facts (beliefs or impressions, as the case may be) that led Japan in 1972 to establish the *Kokusai Koryu Kikin*, the Japan Foundation. There had been a variety of public and private groups involved in international cultural exchange prior to 1972. However, there was no single national organization dedicated to that purpose. Indeed, cultural exchange between Japan and the United States has been largely financed by the United States. The new foundation's goal is to "efficiently carry on activities for international cultural exchange and thereby to contribute to the enhancement of world culture and the welfare of mankind, with a view to deepening other nations' understanding of Japan, . . ." according to its chapter.

Its operations are manifold and include:

1. supporting individuals from overseas, and Japanese abroad, for the purpose of implementing international cultural exchange;
2. promoting knowledge of the Japanese language;
3. promoting Japanese studies abroad and subsidizing research about Japan;
4. sponsoring and supporting exhibitions, lectures, and seminars; and
5. preparing, collecting, exchanging, and distributing materials about Japan.

The foundation, headquartered in a new, attractive but functional building in Tokyo, is supervised by a president (Mr. Kohn Hidemi), who is assisted by four directors and a staff of about 130. In addition, he has the services of more than 50 advisors, 16 of whom are Americans. Over half of the latter group are academicians from such major universities as the University of California, Columbia, Yale, and Harvard. Besides the necessary administrative, financial, and accounting departments, the foundation has separate departments for the exchange of persons, Japanese studies, arts, publications, and audio-visual activities. It maintains a separate office in Kyoto and has nine overseas liaison offices including three in the United States: Washington, D.C., New York, and Los Angeles. It also maintains cultural institutes in Rome and Cologne.

Many of the activities of the foundation are handled by the Japanese Studies Center, a special unit established in 1976. It serves as a clearing house for inquiries in the arts, humanities, and social sciences; trains students who wish to teach Japanese abroad; and assists foreign groups conducting study tours of Japan.

A library at the Tokyo center contains some 20,000 volumes, including most of the books in the humanities and social sciences dealing with Japan that were published prior to the second world war. The library, which is open to the public, caters to foreign scholars and researchers in Japan.

In 1978, the foundation budget amounted to just under ¥5,000 million (about $25 million), of which 72 percent was distributed among its four major activities approximately as follows: exchange of persons, $4.7 million; Japanese studies, $5.6 million; exhibitions and performances, $2.7 million; and activities to introduce Japanese culture abroad, $1.7 million. The 1978 budget represents an eight-fold increase over that of its initial year, 1972.

The exchange of persons program is one of the foundation's most important activities. It operates a two-way-street in that it sends Japanese specialists abroad and brings foreign specialists to Japan. Although this program has emphasized the exchange of scholars and researchers, it also has arranged exchanges with the developing countries in sports, crafts, and education. Most exchanges have been with Asia and the United States.

The United States benefits mainly from the foundation's exchange program, and especially from the fellowships granted U.S. scholars. These fellowships are available to both professionals and doctoral candidates in the social sciences and humanities. They are not available for research in the physical, natural, medical, or engineering sciences. Although I am a coastal morphologist, my research proposal received support because it deals with human modification of the coast and the effects of this modification on coastal processes, form, and utilization.

In 1977, 152 individuals were sent abroad from Japan and 612 foreigners visited Japan, 376 in groups. Of the 236 who visited as individuals, 77 (out of 460 applicants) from 26 countries were awarded long-term fellowships for the purpose of conducting research in Japan. This number included 57 professional fellowships (4-12 months) and 20 doctoral dissertation fellowships (6-14 months). In 1978, 478 applications were processed; 100 were awarded fellowships. Of the 152 Japanese fellows who went abroad in 1977 under foundation sponsorship, 15 visited the United States; 12 on short-term visits. The number of Americans conducting research in Japan in 1977 was 56, including 18 who were continuing their grants from 1976. Of the 56, exactly half were Ph.D. candidates. Research topics, selected from the list included studies of the prehistory of Japan, socio-economic development, policy toward the aged, business in Japan's imperialist expansion, agrarian life, reform in higher education, natural imagery in the *Tale of Genji*, ethnography of Japanese irrigation systems, and Japanese pollution litigation.

The foundation's Japanese studies department contains two divisions; one for the Japanese language, the other for other Japanese studies. The language program aims at helping maintain or improve the level of teaching Japanese in universities around the world. In 1977, 50 Japanese specialists were sent to 22 countries to teach in 33 different universities. During the same year, this program also furnished salary assistance to 363 local instructors in 35 countries, donated teaching materials to 207 institutions in 55 countries, and brought 33 individuals from 12 countries to Tokyo for a six-week teacher training program.

The Japanese studies program has similar objectives, although in non-language related subjects. It has been responsible for the establishment of chairs in Japanese studies in eight universities. In 1977, it sent 58 professors and lecturers (10 to the U.S.) to 34 colleges and universities around the world.

The foundation sponsors a variety of other activities that introduce Japanese culture abroad and, although of lesser priority, that promote the understanding of other cultures by the Japanese. Performances abroad have been numerous and include a variety of art exhibitions and live performances. The visit by the Peking Opera Theater of China to Japan (September, 1979) is an example of the second type of activity.

Publication is also varied. The foundation publishes scholarly works related to Japanese culture, English translations of works of Japanese culture, and bibliographies for Japanese studies among others. It issues *The Japan Foundation Newsletter*, which was initiated in 1973 and is published bimonthly in English. (It is distributed free of charge to persons and organizations interested in Japanese studies. If interested, send name and address to the Editor, *The Japan Foundation Newsletter*, 3-7-1 Kasumigaseki, Chiyoda-ku, Tokyo 100, Japan.) Each issue, now averaging about 30 pages in length, carries reports on research, general articles on Japanese culture, and announcements of foundation activities. One of its most useful features is a continuing series of reviews of Japanese studies in foreign countries. In December, 1976 the Japanese studies center began publication of a bulletin entitled *Center News*. Published five times a year, it is printed in both Japanese and English and is intended for foreign students and scholars of Japanese studies.

The Japan Foundation, since its recent inception, has made great strides in "deepening other nation's understanding of Japan." Over 3000 foreign scholars have visited Japan on its grants and over 1000 Japanese have been sent abroad to introduce Japanese academic and cultural activities to more than 100 countries.

If its program continues to expand at the present rate, the Japan Foundation will prove to be a major factor in eliminating the necessity for such statements as quoted in the first part of this article.

INCREASED REACTIVITY OF NATURAL SUBSTANCES

Rudolph J. Marcus

Dr. Isao Kaetsu is chief of Process Laboratory III, Takasaki Radiation Chemistry Research Establishment of Japan Atomic Energy Research Institute (JAERI), 1233 Watanuki-cho, Takasaki-shi, Gunma-ken, Japan 370-12. There are eight people in his laboratory, of whom five as Ph.D.'s. They have specialized in the "immobilization" of natural substances. This process appears to preserve the structural or conformational integrity of the natural substances, and thus preserves the biological (catalytic) activity of these substances through many successive reaction cycles. Lifetime increases from minutes or hours to months are claimed for photolysis of water by chloroplasts and for cellulose breakdown to form glucose.

The "immobilization" process consists of freezing aqueous solutions or suspensions of the active materials (chloroplasts in one case, the enzyme cellulase in the other) at -80°C. The solution also contains a vinyl monomer like a hydroxyethylmethacrylate or polyethyleneglycol diacrylate. Irradiation of the frozen solution in a 500,000-curie cobalt-60 source produces a polymethacrylate. Melting of the water leaves many interstices to which the active material adheres. The adhesion appears to be mechanical rather than involving hydrogen bonding. The material is produced in 5-mm-diameter cylinders, slices of which are then microtomed and suspended in the substrate to be used. Surface areas of active material are said to be 1000 - 10,000 cm^2/g.

The excitement at Kaetsu's Institute, which has led to several newspaper reports, is the use of this technique to suspend the enzyme cellulase for the digestion of cellulose to form glucose. An additional refinement is to immobilize the bacterium *Trichoderma vivide*, which secretes cellulase, rather than only cellulase itself. In the process, finely divided saw dust, rice husks, chaff, etc., is suspended in water and exposed to the immobilized enzyme in two successive reactors. The unreacted material is filtered off and returned to the initial reactor, somewhat like a solera system. Yields of the bench top process are said to be 10-30% of theoretical.

Newspaper reports made much of "radiation pretreatment" of the cellulosic feedstock. A 10^8-rad dose is applied to make the material friable for better suspension in water, but this may only be a function of easy availability of a cobalt-60 source. A ball mill might do just as well.

The chloroplast work has not been applied as much as the cellulose work. Oxygen evolution at high efficiency has been noted for over a month under conditions at which traditional chloroplast suspensions function for only three hours.

A slightly different vinyl monomer, glyceryl methacrylate, allows controlled leakage of the active substance. Kaetsu produces polymers containing adreamycin, an antibiotic, which are being evaluated in animal trials by Professors Yasuhisa Sakurai and Akiyoshi Yamada of Tokyo Women's Medical College, 10, Kawada-cho, Ichigaya, Shinjuku-ku, Tokyo, Japan 162.

A selected bibliography of Kaetsu's publications follows.

1. "Radiation-Induced Decomposition and Enzymatic Hydrolysis of Cellulose" by Minoru Kumakura and Isao Kaetsu. Biotechnology and Bioengineering, *20*, 1309-1315 (1978).
2. "Immobilization of Streptomyces phaeochromagenes Cells at a High Concentration by Radiation-Induced Polymerization of Glass-Forming Monomers" by Minoru Kumakura, Masaru Yoshida, and Isao Kaetsu. European J. Appl. Microbiol. Biotechnol. *6*, 13-22 (1978).

3. "Controlled Release of Biofunctional Substances by Radiation-Induced Polymerization: 1. Release of Potassium Chloride by Polymerization of Various Vinyl Monomers" by Masaru Yoshida, Minoru Kumakura, and Isao Kaetsu. Polymer, *19*, 1375-1378 (1978).
4. "Controlled Release of Biofunctional Substances by Radiation-Induced Polymerization: 2. Release of Potassium Chloride from Porous Poly (Diethylene Glycol Dimethacrylate)" by Masaru Yoshida, Minoru Kumakura, and Isao Kaetsu. Polymer, *19*, 1379-1381 (1978).
5. "Immobilization of Enzymes by Radiation-Induced Polymerization of Glass-Forming Monomers: 1. Immobilization of Some Enzymes by Poly (2-Hydroxyethyl Methacrylate)" by Masaru Yoshida, Minoru Kumakura, and Isao Kaetsu. Polymer, *20*, 3-8 (1979).
6. "Immobilization of Enzymes by Radiation-Induced Polymerization of Glass-Forming Monomers: 2. Effects of Cooling Rate and Solvent on Porosity and Activity of Immobilized Enzymes" by Masaru Yoshida, Minoru Kumakura, and Isao Kaetsu. Polymer, *20*, 9-12 (1979).
7. "Radiation-Induced Degradation and Subsequent Hydrolysis of Waste Cellulose Materials" by Minoru Kumakura and Isao Kaetsu. International Journal of Applied Radiation and Isotopes, *30*, 139-141 (1979).
8. "Preparation of Fresnel Lens Film by Mold Polymerization Using Electron Beam Irradiation" by Hiroshi Okubo, Kenzo Yoshida, and Isao Kaetsu. International Journal of Applied Radiation and Isotopes, *30*, 209-212 (1979).
9. "Drug Entrapment for Controlled Release in Radiation-Polymerized Beads" by Masaru Yoshida, Minoru Kumakura, and Isao Kaetsu. Journal of Pharmaceutical Sciences, *68-5*, 628-631 (May 1979).
10. "Immobilization of Streptomyces phaerochromogenes by Radiation-Induced Polymerization of Glass-Forming Monomers" by Minoru Kumakura, Masaru Yoshida, and Isao Kaetsu. Biotechnology and Bioengineering, *21*, 679-688 (1979).
11. "Enzyme Immobilization by Radiation-Induced Polymerization of 2-Hydroxyethyl Methacrylate at Low Temperatures" by Isao Kaetsu, Minoru Kumakura, and Masaru Yoshida. Biotechnology and Bioengineering, *21*, 847-861 (1979).
12. "Enzyme Immobilization by Radiation-Induced Polymerization of Hydrophobic Glass-Forming Monomers at Low temperatures" by Isao Kaetsu, Minoru Kumakura, and Masaru Yoshida. Biotechnology and Bioengineering, *21*, 863-873 (1979).

INTERNATIONAL MEETINGS IN THE FAR E AST

1979-1982

compiled by Seikoh Sakiyama

It is intended to update and augment this list in future issues of the Scientific Bulletin. The assistance of Dr. T. D. C. Grace, Australian Embassy, Tokyo, and Dr. M. J. McNamara, New Zealand Embassy, Tokyo, in supplying a listing of meetings in their countries is deeply appreciated.

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Date	Title	Site	For information contact
October 1-5	INCHEM Tokyo 79 and International Forum 79	Tokyo, Japan	Japan Management Association Kyoritsu Bldg. 1-22, 3-chome, Shiba-koen Minato-ku, Tokyo 105
October 1-5	RACI Cereal Chemistry Div. 29th Annual Meeting	Adelaide, S.A., Australia	Mr. Tas Wescott, Secretary, Arnott Motteram Menz Pty Ltd G.P.O. Box 1572 Adelaide, S.A. 5001
October 29-Nov. 3	The 3rd International Congress of Quantum Chemistry (ICQC Kyoto '79)	Kyoto, Japan	Secretariat of ICQC Kyoto International Conference Hall Takara-ike, Sakyo-ku, Kyoto 606
October 30-31	Symposium on Design of Inorganic and Organic Materials of Technological Importance	Kyoto, Japan	Dept. of Hydrocarbon Chemistry, Kyoto University Yoshida-Hommachi, Sakyo-ku Kyoto 606
November 1	Workshop of Reproductive Immunology	Kyoto, Japan	Mr. Shinzo Isojima Department of Obstetrics and Gynecology Hyogo Medical College 1-1, Mukogawa-cho, Nishinomiya Hyogo 663
November 2	International Federation of Gynecology and Obstetrics Kyoto Symposium	Kyoto, Japan	Dr. Takeshi Mori Kyoto Gynecologists Association Kyoto International Conference Hall Takara-ike, Sakyo-ku Kyoto 606

Date	Title	Site	For information contact
November 3	Annual Gen. Meeting & Convention of the A'asian College of Biomedical Scientists	North Ryde, N.S.W., Australia	Ms. Monica Wood Pathology Dept. Hornsby Dist. Hospital Hornsby, N.S.W. 2077
November 5-6	Quantum-Chemical Aspects of Biomolecules–their structures and functions	Kyoto, Japan	National Cancer Center Research Institute, 5-1-1, Tsukiji, Chuo-ku Tokyo 104
November 7-15	Community Consultative International Telephone and Telegraph (C.C.I.T.T.) Meeting of Study Group XIV	Kyoto, Japan	Mr. Hikari Chono Minister's Secretariat Ministry of Post and Telecommunications 1-3, Kasumigaseki, Chiyoda-ku Tokyo 100
November 13-16	IMEKO (International Measurement Confederation) Symposium on Flow-Measurement and Control in Industry	Tokyo, Japan	IMEKO The Society of Instrument and Control Engineers, Japan Kotohira Annex, 1-15-5 Toranomon, Minato-ku Tokyo 105
November 18-23	9th World Conference on Non-destructive Testing	Melbourne, Australia	Dr. R. B. Oke NATA 191 Royal Parade, Parkville Vic. 3052
November 20-21	The 14th Japan Conference on Radioisotopes	Tokyo, Japan	Mr. M. Izawa, Chief Section for Industrial Program and Technology Japan Atomic Industrial Forum, Inc. 1-13, 1-chome, Shimbashi Minato-ku, Tokyo 105
November 25-29	International Conference on Tropical Cyclones	Perth, W.A. Australia	Mr. A. B. Neal Conference Coordinator C/- G.P.O. Box 1289K Melbourne, Vic. 3001
November 26-29	Second JIM International Symposium on Hydrogen in Metals (JIMIS-2)	Gumma, Japan	The Japan Institute of Metals Aramaki Aoba, Sendai City 980
November 26-30	2nd International Child Neurology Congress	Wentworth, Australia	2nd International Child Neurology Congress, GPO Box 3866 Sydney, NSW 2001

Date	Title	Site	For information contact
November 26-30	Annual Conference of Australasian Corrosion Association	Perth, Australia	Mr. D. Harben, PO Box 71 East Victoria Park, WA, 6101
November 27-28	Microprocessors Symposium	Melbourne, Australia	The Institution of Engineers, Australia, 11 National Circuit. Barton, ACT, 2600
November 28-30	International Conference of Statistics	Tokyo, Japan	Dr. T. Matsunawa The Institute of Statistical Mathematics Room #234 4-6-7 Minami-Azabu Minato-ku, Tokyo 106
November 28-30	STIP Symposium on Solar Radio Astronomy, Interplanetary Scintillations & Coordination with Spacecraft	Narrabri, NSW., Australia	Mr. G. Nelson, CSIRO (Culgoora) Solar Observatory, Narrabri. NSW
November 29-December 1	Clinical Oncological Society, Annual Scientific Meeting	Melbourne, Australia	Clinical Oncological Society of Australia, Box 4708, GPO Sydney NSW, 2000
December 2-15	International Union of *Geodesy and Geophysics*	Canberra, A.C.T., Australia	Mr. B. P. Lambert. Executive Director Organizing Committee for IUGG 1979 Div. of National Mapping. P.O. Box 548 Queanbeyan, N.S.W. 2620
December 10-14	20th International Conference on Coordination Chemistry	Calcutta, India	Secretariat Indian Chemical Society 92 Acharya Prafulla Chandra Road, Calcutta 700009
December 16-19	Australian Society for Medical Research Annual Scientific Meeting	Thredbo, NSW., Australia	The ASMR, 145 Macquarie St. Sydney, NSW, 2000
December 17-19	Impact of the First GARP Global Experimental & Preliminary Australasian Assessment	Melbourne, Vic., Australia	Dr. D. J. Gautlett A.N.M.R.C. P.O. Box 5089AA GPO Melbourne, Vic. 3001

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Date	Title	Site	For information contact
December 17-19	Third Southwest Pacific Workshop Symposium (Final Meeting IGCP 110 Evolution of India-Pacific Plate Borders)	Sydney, Australia	Dr. Gordon Packham Department of Geology and Geophysics University of Sydney N.S.W. 2006
December	Fluid Mechanics	Brisbane, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600

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January 30-February 2	12th Meeting of Australian Crystallographers	Canberra, Australia	Dr. G. McLaughlan, Research School of Chemistry, ANU, PO Box 4 Canberra, ACT, 2600
February 3-7	Coordination and Metallo-Organic Division (COMO-9)	Sydney, Australia	Dr. I. Dance, School of Chemistry Uni NSW, PO Box 1, Kensington NSW, 2033
February 3-8	VIII International Thyroid Congress	Sydney, Australia	Australian Academy of Science PO Box 783, Canberra City, ACT 2601
February 4-8	Australian X-Ray Analytical Association School/Conference	Canberra, Australia	Conference Secretary, c/-NSW Institute of Technology, PO Box 123, Broadway NSW, 2007
February 5	6th Aust. Conference on Electron Microscopy	Clayton, Vic. Australia	Dr. W.C.T. Dowell, CSIRO Division of Chemical Physics P.O. Box 160 Clayton, Vic. 3168
February 10-16	6th International Congress of Endocrinology	Melbourne, Vic. Australia	Aust. Academy of Science P.O. Box 783 Canberra City, A.C.T. 2601
February 11-22	UN Regional Cartographic Conference for Asia and the Pacific	Wellington, New Zealand	Dept. of Land and Survey Private bag, Charls Fergusson Bldg. Wellington
February 16-21	Australian Dental Association Hobart Convention	Hobart, Australia	Dr. H. Hammer, Chairman, 130 New Town Rd., New Town, Tas., 7008
February 17-20	Conference on Molecular Physics and Quantum Chemistry	Sydney, Australia	Dr. P.G. Burton, Dept. Chemistry University Wollongong Wollongong, NSW, 2500

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Date	Title	Site	For information contact
February	6th Congress of the Asian Pacific Assn. of Gastroenterology	Auckland, New Zealand	Asian Pacific Congress of Gastroenterology Department of Gastroenterology Auckland Hospital Park Auckland
February	5th Gondwana Symposium	Wellington, New Zealand	Royal Society of New Zealand Box 12249, Wellington
March 9-10	Migration and Health	Wellington, New Zealand	Wellington Post Graduate Society Epidemiology Unit Wellington Clinical School M.S.R.U.
March 9-14	Australasian Society of Nephrology Annual Scientific Meeting	Adelaide, Australia	Dr. B.M. Saker, Australasian Society of Nephrology, Renal Unit, Royal Perth Hospital, Perth, WA, 6000
March 23-29	17th International Coastal Engineering Conference	Sydney, N.S.W., Australia	Institution of Engineers 11 National Circuit Barton, A.C.T. 2600
April 7-10	International Conference and Exhibition on Liquefied Natural Gas	Kyoto, Japan	Dr. Y. Shibazaki The Japan Gas Association 38, Shiba-Kotohira-cho Minato-ku, Tokyo 105
April 7-11	International Conference on Plasma Physics (IUPAP)	Nagoya, Japan	Prof. Y. Ichikawa Institute of Plasma Physics Nagoya University Furo-cho, Chikusa-ku Nagoya 464
April 19- May 8	International Marine Biological Workshop	Hong Kong China	Dr. B.S. Morton University of Hong Kong Pokfulam Road, Hong Kong
April 29-30	Ninth BMR Symposium 1980	Canberra, Australia	Mrs. E.E. Young, Bureau of Mineral Resources, PO Box 378 Canberra City, ACT, 2601
May 7-9	Foundations on Rock	Sydney, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT 2600
May 12-14	Australian Physiological and Pharmacological Society	Brisbane, Australia	Dr. S.R. O'Donnell, Dept. Physiology Uni Queensland, St. Lucia, Qld., 4067

Date	Title	Site	For information contact
May 12-14	4th National Conference of the Australian Plant Pathology Society	Perth, Australia	Dr. G.D. McLean, Department of Agriculture, Jarrah Rd., South Perth WA, 6151
May 12-15	The 3rd International Meeting on Radiation Processing (IMRAP-3)	Tokyo, Japan	Secretariat of (IMRAP-3) Takasaki Radiation Chemistry Research Establishment Institute Japan Atomic Energy Research 1233 Watanuki-cho, Takasaki Gumma, 370-12
May 12-16	Australia-NZ Geomechanics Conference	Wellington, New Zealand	Victoria University Wellington
May 12-16	Australian Biochemical Society Annual Meeting	Melbourne, Australia	Dr. H.C. Robinson, Biochemistry Dept. Monash University, Clayton, Vic., 3168
May 12-16	ANZAAS Jubilee Congress	Adelaide, Australia	Executive Secretary, ANZAAS 157 Gloucester Street, Sydney NSW, 2000
May 12-16	Royal Australian College of Physicians	Sydney, Australia	RACP, 145 Macquarie Street Sydney, NSW, 2000
May 19-22	4th International Conference on Titanium	Kyoto, Japan	The Japan Institute of Metals Aramaki Aoba, Sendai 980
May 20-23	Australian Society for Microbiology and the New Zealand Microbiological Society	Dunedin, New Zealand	Australian Society for Microbiology 191 Royal Pde, Parkville, Vic., 3052 Australia
May 21-30	FAO Indo-Pacific Fishery Commission (IPFC) 19th Session	Kyoto, Japan	Mr. Koji Imamura Research Division Fisheries Agency 1-2, Kasumigaseki, Chiyoda-ku Tokyo 100
May 26-28	Second Australian Energy Conference	Melbourne, Australia	Dr. D.R. Warren ARL GPO Box 4331, Melbourne 3001
May (Tentative)	Annual Conference Australasian Institute of Mining & Metallurgy	New Zealand	Mr. L.S. Jones New Zealand Branch Australian Institute of Mining and Metallurgy Box 6342 TE ARO Wellington

Date	Title	Site	For information contact
May (Tentative)	International Archaean Symposium	Nedlands, W.A., Australia	Dr. J.A. Hallberg CSIRO Div. of Mineralogy Private Bag P.O. Wembley, W.A. 6014
May (Tentative)	28th International Congress of Physiology	Australia (undecided)	Assistant Secretary Aust. Academy of Science P.O. Box 216 Civic Square, A.C.T. 2608
June 1-3	The 8th International Conference on Oral Biology	Tokyo, Japan	Association of Oral Hygiene 1-38-6, Komagome, Toshima-ku Tokyo 171
June 2-6	Joint Conference of Fourth International Congress on Waves and Instabilities in Plasmas and Fourth Kiev International Conference on Plasma Theory (International Conference of Plasma Physics)	Tokyo, Japan	Prof. K. Nishikawa Faculty of Science *Hiroshima University* 89-1-1, Higashi-Senda-cho Hiroshima 730
June 5-8	Congress of the International Association for Dental Research	Osaka, Japan	Prof. Y. Kawamura Dental School, Osaka University 32, Joan-cho, Kita-ku, Osaka 530
June 19-20	Regional Meeting for Burn Injuries in Japan	Sapporo, Japan	Prof. Junji Hamamoto M.D., Dept. of Plastic & Reconstructive Surgery, School of Medicine, Hokkaido University Kita 14, Nishi 5, Kita-ku, Sapporo 066 Headquarters: The International Society for Burn Injuries, 4200 E, Ninth Av. Box C-309 Denver, Colorado 80262, U.S.A.
June 23-26	3rd World Hydrogen Energy Conference	Tokyo, Japan	Japan Convention Service, Inc. Nippon Press Center Bldg. 8F 2-2-1, Uchisaiwai-cho Chiyoda-ku, Tokyo 100
June 30-July 4	The Eighth International Liquid Crystal Conference	Kyoto, Japan	Prof. Shunsuke Kobayashi, Dept. of Electric Engineering, Faculty of Technology, Tokyo University of Agriculture and Technology, 2-24-16 Nakamachi, Koganei-shi, Tokyo 184

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Date	Title	Site	For information contact
July 30-July 4	The Seventh International Congress on Catalysis	Tokyo, Japan	Prof. I. Yasumori Dept. of Chemistry, Faculty of Science Tokyo Institute of Technology 2-12-1, Ookayama, Meguro-ku Tokyo 152
July 7-11	10th IUPAC International Symposium on Carbohydrate Chemistry	Sydney, Australia	Australian Academy of Science P.O. Box 783, Canberra ACT 2601
July 9-16	Australian Acoustical Society "Acoustics in the 1980s"	Sydney, Australia	The Australian Acoustical Society Tenth ICA Executive Committee The Science Centre 35 Clarence Street, Sydney, NSW 2000
July 19-20	ICA-1980 Associated Acoustics Conference	Auckland, New Zealand	ICA-1980 Associated Conference P.O. Box 1181 Auckland
July 20	10th International Conference on Acoustics	New Zealand	Dr. C. Balachandron New Zealand Acoustic Society D.S.I.R. Private bag Lower Hutt
July 22-29	Vth International Symposium on Biological Control of Weeds	Brisbane, Qld., Australia	CSIRO Div. of Entomology Private Bag 3 Indooroopilly, QLD. 4068
August 3-9	XVI International Congress of Entomology	Kyoto, Japan	Kyoto International Conference Hall Takara-ike, Sakyo-ku, Kyoto 606
August 18-22	7th Australasian Hydraulics and Fluid Mechanics Conference	Brisbane, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600
August 18-22	5th Australian Electro-chemistry Conference	Perth, Australia	Professor A.J. Parker, Murdoch University Murdoch, WA, 6153
August 18-22	4th International Conference on Production Engineering	Tokyo, Japan	The Japan Society of Precision Engineering Scramikkusu Bldg., 2-22-17, Hyakunin-cho Shinjuku-ku, Tokyo 160

Date	Title	Site	For information contact
August 24-31	The 21st Congress of International Association of Theoretical and Applied Limnology	Kyoto, Japan	Assistant Prof. T. Miura c/o Otsu Hydrobiological Station Kyoto University Shimosaka-Honmachi, Otsu 520-01
August 25-29	8th Asian Congress of Pharmaceutical Sciences of the Federation of Asian Pharmaceutical Associations	Kyoto, Japan	Japan Pharmaceutical Association 2-12-15-701, Shibuya, Shibuya-ku. Tokyo 150 Headquarters: The Federation of Asian Pharmaceutical Associations (FAPA), Hizon Bldg., 29 Quezon Bd., Quezon City, Phillippines
August 25-29	12th Australian Spectroscopy Conference	Sydney, Australia	Australian Academy of Science P.O. Box 783, Canberra City, ACT 2601
August 25-29	4th National Congress, Australian Institute of Physics	Melbourne, Australia	Dr. R.J. Fleming, Dept. of Physics, Monash University, Clayton, Vic., 3052
August 25-31	International Conference Manufacturing Engineering	Melbourne, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600
August 25-September 1	The 10th International Cartographic Conference and the 6th General Assembly of the International Cartographic Association	Tokyo, Japan	Mr. K. Nishimura Japan Map Center Kudan Pompian Building 8-8, 4-chome, Kudan-Minami Chiyoda-ku, Tokyo 102
August 31-September 5	General Assembly, the 15th International Geographical Union, and the 24th International Geographical Congress	Tokyo, Japan	Prof. S. Yamamoto Rissho University 16-2-4, Ohsaki, Shinagawa-ku Tokyo 141
August/September (Tentative)	16th Meeting of the Scientific Committee for Antarctic Research (SCAR)	Queenstown, New Zealand	Royal Society of New Zealand Box 12249, Wellington
September 1-5	15th International Conference on the Physics of Semi-conductors	Kyoto, Japan	Assistant Prof. K. Kamimura Dept. of Physics, Faculty of Science University of Tokyo 1-3-7, Hongo, Bunkyo-ku Tokyo 113

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Date	Title	Site	For information contact
September 15-19	4th Asian Symposium on Medical Plants and Spices	Bangkok, Thailand	Dr. Vichai Reutrakul Department of Chemistry Faculty of Science Mahidol University Rama VI Road Bangkok 4
September 22-25	Eighth International Conference of Occupational Health in the Chemical Industry	Tokyo, Japan	Prof. N. Takemura Jikei University School of Medicine Minato-ku, Tokyo 105
September 29-October 2	Symposium 1980 I.A.H.R. (International Association for Hydraulic Research), Section for Hydraulic Machinery Equipment and Cavitation	Tokyo, Japan	Prof. Dr. Masaaki Shirakura, Faculty of Engineering, University of Tokyo 7-3-1, Hongo, Bunkyo-ku, Tokyo 113 Headquarters: International Association for Hydraulic Research (IAHR), Sec. Prof. Ir. H. J. Schoemaker, Rotterdamseweg 185, PB177 Delft, Netherlands
September 29-October 4	The 3rd World Conference on Medical Informatics (MEDINFO 80)	Tokyo, Japan	MEDINFO 80 Organizing Committee c/o MEDIS-DC, Hongo, P.O. Box 4Q Bunkyo-ku, Tokyo 113-91
September 30-October 3	The 3rd International Conference on Ferrites	Kyoto, Japan	Prof. M. Sugimoto Dept. of Electronics Faculty of Engineering Saitama University 255, Shimo-Ohkubo, Urawa Saitama 338
September 30-October 4	The 8th International Conference on Computative Linguistic (COLING 80)	Tokyo, Japan	Prof. Makoto Nagao Department of Electronics Engineering Faculty of Engineering Kyoto University Yoshida-Honcho, Sakyo-ku Kyoto 606
October 1-3	The 10th International Symposium on Fault-Tolerant Computing	Kyoto, Japan	G. S. Mr. Shoji Watanabe, Kokusai Denshin Denwa Co., Ltd., 2-3-2 Nishi-Shinjuku, Shinjuku-ku, Tokyo 160

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Date	Title	Site	For information contact
October 6-9	The 8th World Computer Congress I.F.I.P. (The International Federation for Information Processing) Congress '80	Tokyo, Japan	Information Processing Society of Japan, Kikai Shinko Kaikan 3-5-8, Shiba-Koen, Minato-ku Tokyo 105
October 6-10	Thirteenth Symposium on Naval Hydrodynamics	Tokyo, Japan	Prof. Takao Inui Department of Naval Architecture Faculty of Engineering University of Tokyo 7-3-1, Hongo, Bunkyo-ku Tokyo 113
October 8-14	The 12th CODATA General Assembly and the 7th International CODATA Conference	Tokyo, Japan	Prof. T. Shimanouchi College of Science Tsukuba University Saiki, Sakura-mura, Niihari-gun Ibaraki 300-31
October 12-17	10th World Congress on Metal Finishing (INTERFINISH '80)	Kyoto, Japan	The Metal Finishing Society of Japan Kyodo Bldg. 2, Kanda-Iwamoto-cho Chiyoda-ku, Tokyo 101
October 13-17	The 6th International Symposium on the Transport of Dangerous Goods by Sea and Inland Waterways	Tokyo, Japan	Japan Marine Surveyors and Sworn Measurer's Association Kaiji Bldg., 1-9-7, Hatchobori Chuo-ku, Tokyo 104
October 13-17	Electric Energy Conference	Sydney, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600
October 14-17	8th World Computer Congress (International Federation for Information Processing)	Melbourne, Vic. Australia	8th World Computer Congress P.O. Box 880G Melbourne, Vic. 3001 (Mr. A.W. Goldsworthy State Govt. Insurance Office (Qld) Box 1453 G.P.O. Brisbane, QLD. 4001)
October 26-31	The 3rd International Meeting on Radiation Processing	Tokyo, Japan	Research Corporaton Section Administration Division, Takasaki Radiation Chemistry Research Establishment, Japan Atomic Energy Research Institute, 1233 Watanukicho Takasaki-shi, Gumma 370-12

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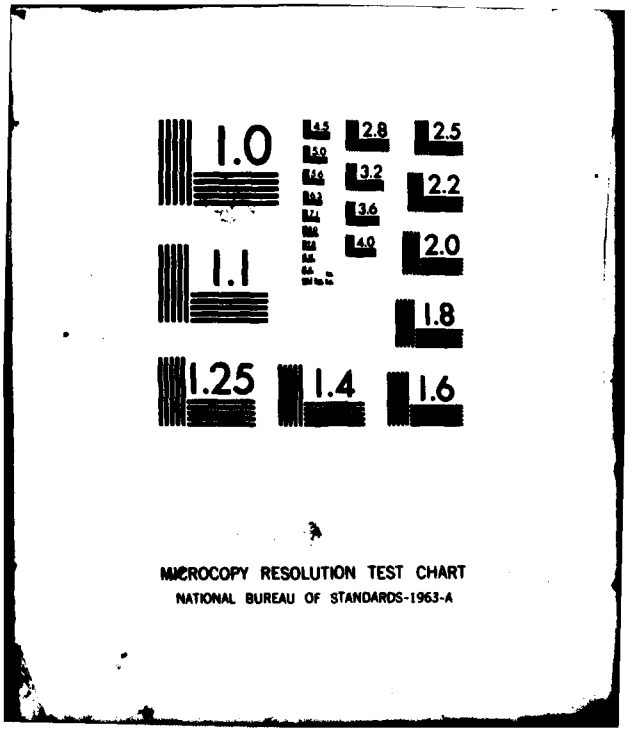
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Date	Title	Site	For information contact
October (Tentative)	RACI Cereal Chemistry Div 30th Annual Conference	Melbourne, Australia	Dr. R.A. Orth Aust. Wheat Board G.P.O. Box 4562 Melbourne, Vic. 3001
November 4-6	Hydrology and Water Resources Symposium	Adelaide, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600
November 10-14	Magneto Hydrodynamic Congress	Adelaide, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600
November 10-19 (Tentative)	Xth International Conference on Lighthouses and Other Aids to Navigation	Tokyo, Japan	Navigation Aid Dept. Maritime Safety Agency 2-1-3, Kasumigaseki, Chiyoda-ku Tokyo 100
November 18-20	Microprocessors Conference	Sydney, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600
November 24-28	1st International Conference on Technology for Development	Canberra, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600
December 1-5	4th International Symposium on Nitrogen Fixation	Canberra, Australia	Dr. A. H. Gibson CSIRO Div. of Plant Industry Box 1600, Canberra, ACT 2601
December 4-5	Lubrication Conference	Melbourne, Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600

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January 25-31	International Symposium on Erosion and Sediment Transport in Pacific Rim Steeplands	Canterbury, New Zealand	Royal Society of New Zealand Box 12249, Wellington
January 31-February 4	Conference on Large Earthquakes	Napier, New Zealand	Royal Society of New Zealand Box 12249, Wellington
February 11-18	International Conference on Soils with Variable Charge	Massey, New Zealand	Royal Society of New Zealand Box 12249, Wellington

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Date	Title	Site	For information contact
April 26- May 1	1st Asian and Pacific Chemistry Congress	Singapore, Republic of Singapore	The Congress Secretary 1st Aspac Congress Singapore Professional Center 129B Block 23 Ontram Park Singapore 0316 *Republic of Singapore*
May 11-15	4th International Conference on Trace Metabolism in Man & Animals (TEMA)	Perth, Australia	Australian Academy of Science PO Box 783, Canberra City, ACT, 2601
May 11-15	Australian Biochemical Society Annual Meeting	Adelaide, Australia	Dr. H. C. Robinson, Dept. Biochemistry Monash University, Clayton, Vic., 3168
May 16-22	The 12th IAPH (International Association of Ports and Harbors) Conference	Nagoya, Japan	Nagoya Port Authority 1-8-21 Irifune, Minato-ku Nagoya 455
May (Tentative)	34th Annual Metals Congress	Sydney, Australia	Undecided
May (Tentative)	Electric Energy Manufacturing Conference	Australia	The Institution of Engineers, Australia 11 National Circuit, Barton, ACT, 2600
July 19-24	8th International Congress of Pharmacology– IUPHAR	Tokyo, Japan	The Japanese Pharmacological Society Gatsukai Center Bldg. 4F, 2-4-16 Yayoi, Bunkyo-ku, Tokyo 113 Headquarters: International Union of Pharmacology c/o Roche Research Center, Nutley New Jersey 07110, U.S.A.
July 27- August 1	The 4th International Congress of Biorheology	Tokyo, Japan	Japanese Society of Biorheology c/o Physics Laboratory, Keio University 4-1-1, Hiyoshi, Kohoku-ku, Yokohama 223 Headquarters: International Society of Biorheology c/o Division of Neurology University of Oregon Health Science Center Portland, Oregon, 97201, U.S.A.

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Date	Title	Site	For information contact
August 21-28	XIII International Botanical Congress	Sydney, N.S.W. Australia	Executive Secretary Dr. W. J. Cram, School of Biological Sciences University of Sydney N.S.W., 2006
August 24-28	International Federation of Automatic Control (IFAC) 8th Triennial World Congress	Kyoto, Japan	Prof. Y. Sawaragi Dept. of Applied Mathematics and Physics, Faculty of Engineering Kyoto University Yoshida-Honmachi, Sakyo-ku Kyoto 606
August (Tentative)	17th Annual Congress of the Australian and New Zealand College of Psychiatrists	Victoria, Australia	Undecided
September 1-5	9th ICAS-XXII CSI (9th International Conference on Atomic Spectroscopy and XXII Colloquium Spectroscopium Internationale)	Tokyo, Japan	The Japan Society for Analytical Chemistry, 9th ICAS-XXII CSI Gotanda-Sanhaitsu 26-2, 1-chome, Nishi-gotanda Shinagawa-ku, Tokyo 141
September 12-18	The 10th International Congress of Electro-encephalography and Clinical Neurophysiology	Kyoto, (Undecided) Japan	International Conference Organizers, Inc., Crescent Plaza 103 2-4-6, Minami-Aoyama Minato-ku, Tokyo 107
September 17-21	The 14th World Congress of International League against Epilepsy and the 13th Symposium of the International Bureau for Epilepsy	Kyoto, Japan	International Conference Organizers, Inc. Crescent Plaza 103, 2-4-6, Minami-Aoyama, Minato-ku, Tokyo 107
September 20-23	1981 International Symposium on Gallium Arsenide and Related Compounds	Kanagawa, Japan	Prof. H. Yanai, Dept. of Electronic Engineering, University of Tokyo 7-3-1, Hongo, Bunkyo-ku, Tokyo 113
September 20-25	12th World Congress of Neurology	Kyoto, Japan	Simul International, Inc. No. 9 Kowa Bldg., 1-8-10, Akasaka Minato-ku, Tokyo 107
September 23-25	Australasian Society of Nephrology joint meeting with Cardiac Society	Brisbane, Australia	Dr. B. M. Saker, Renal Unit, Royal Perth Hospital, Perth, WA, 6000

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Date	Title	Site	For information contact
September (Tentative)	International Rock Mechanics Symposium on Weak Rock –Soft, Fractured and Weathered Rock	Tokyo, Japan	Japan Society of Civil Engineers 1-chome, Yotsuya Shinjuku-ku, Tokyo 160
September/ October (Tentative)	International Union Conservation of Nature and Natural Resources	Christchurch, New Zealand	Lincoln College Christchurch, Canterbury

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May 23-28	16th International Congress of Dermatology (CID)	Tokyo, Japan	Japan Convention Services, Inc. Nippon Press Center 8F 2-2-1, Uchisaiwai-cho Chiyoda-ku, Tokyo 100
Mid-July (Tentative)	The 5th International Congress of Plant Tissue	Yamanashi, Japan	Assistant Prof. A. Komamine Dept. of Botany, Faculty of Science University of Tokyo 7-3-1, Hongo, Bunkyo-ku Tokyo 113
Aug. 9-Sept. 3	The 5th International Congress of Pesticide Chemistry, IUPAC	Kyoto, Japan	Rikagaku Kenkyusho 2-1, Hirosawa, Wako Saitama 351
August 15-21	International Biochemical Congress	Perth, Australia	Australian Academy of Science and International Union of Biochemistry P.O. Box 783, Canberra, ACT, 2601
August (Tentative)	The Royal Australian Chemical Institute 7th National Convention	Canberra, Australia	Executive Secretary, RACI HQ 191 Royal Parade, Parkville Vic. 3052
August (Tentative)	1982 International Conference on Solid State Devices	Tokyo, Japan	The Japan Society of Applied Physics Kikai-Shinko-Kaikan 5-8, 3-chome, Shibakoen Minato-ku, Tokyo 105
August (Tentative)	International Biochemistry Congress	Perth, W.A. Australia	Australian Academy of Science P.O. Box 783, Canberra City, A.C.T., 2601

Date	Title	Site	For information contact
September (Tentative)	6th International Symposium on Contamination Control	Tokyo, Japan	Japan Air Cleaning Association 6-7-5, Soto-Kanda, Chiyoda-ku. Tokyo 101
October 4-6 (Tentative)	Third International Dental Congress on Modern Pain Control	Tokyo, Japan	Japan Convention Services, Inc. Nippon Press Center 8F, 2-2-1, Uchisaiwai-cho, Chiyoda-ku Tokyo 100
Undecided	International Conference on Mass Spectroscopy	Hawaii, U.S.A.	Prof. T. Tsuchiya Basic Science Lecture Room Chiba Institute of Technology 1-17-2, Tsudanuma, Narashino Chiba 275

CSIRO DIVISION OF MATHEMATICS AND STATISTICS SILVER JUBILEE CONFERENCE

Rudolph J. Marcus

The CSIRO (Commonwealth Scientific and Industrial Research Organization) DMS (Division of Mathematics and Statistics) Silver Jubilee Conference was held 13-17 August 1979 at The Flinders University of South Australia. Although no one from ONR/Tokyo was at this meeting, the abstracts of papers given at this meeting are available at this office and specific ones can be sent to those who request them.

The sessions at this meeting were devoted to

Random geometry
Applied mathematics
Time series
Differential and integral equations
Experimental design
Graphics
Applied multivariate analysis
Optimization
Survival data
Use of minicomputers.

A listing of speakers at this meeting, their addresses, and titles of their papers follows.

	Name and Address	Title
–	Rosalind Anderson DMS, Adelaide*	Some applications for a mini-computer
–	Robert Anderssen DMS, Canberra*	Global optimization
–	N. R. Bartlett DMS, Melbourne*	Looking at grouped survival data
–	John Blake DMS, Canberra*	Applied mathematics in CSIRO. How can DMS help?
–	Chris Brien Roseworthy Agricultural College, Roseworthy, S. A. 5371	Differences between experimental designs elucidated by experimental structure
–	Domenico Bucco Applied Mathematics, University of Adelaide #	A new numerical technique for solving problems of thin structures
–	Murray Cameron DMS, Canberra*	Analysis of time series data
–	Norm Campbell DMS, Perth*	Robust multivariate procedures
–	Nan Carter DMS, Sydney*	Plots for clients
–	Kevyn Cellier DMS, Adelaide*	Experience with large fractional factorial designs

	Name and Address	Title
–	Stephen Clarke Swinburne College of Technology John Street, Hawthorn, Vic. (P.O. Box 218, Hawthorn, 3122)	Different scoring systems in squash
–	David L. Clements Applied Mathematics, University of Adelaide #	The boundary integral equation method for the numerical solution of elliptic partial differential equations
–	Ray Correll DMS, Adelaide*	Use of GENSTAT backing store
–	Ray Correll DMS, Adelaide*	The Australian kidney foundation data--a candidate for survival analysis
–	Richard Cowan DMS, Sydney*	Random geometry
–	Richard Cowan DMS, Sydney*	Hand evaluation in the game of contract bridge
–	Noel Cressie Mathematical Sciences, Flinders University, Bedford Park, S. A. 5042	Image analysis at Fontainebleau: a blend of experimentation and mathematical theory
–	Frank de Hoog DMS, Canberra*	Numerical solution of an integral equation from genetics
–	Frank de Hoog DMS, Canberra*	Introduction to dynamic programming
–	Bernard Ellem DMS, Canberra*	MLP--maximum likelihood program
–	Bernard Ellem DMS, Canberra*	Confidence regions for nonlinear models by reparameterisation
–	Bernard Ellem DMS, Canberra*	Quadratic programming
–	Nick Fisher DMS, Sydney*	Graphical methods in non-parametric statistics
–	Lawrence Forbes Applied Mathematics, University of Adelaide #	2D Fluid flow over submerged obstacles
–	Joe Gani DMS, Canberra*	The role of mathematics and statistics in our society
–	Tony Grassia DMS, Perth*	Diallel analysis in the study of animal behaviour
–	David Griffiths DMS, Sydney*	Fishing for improvements to Mullett's Poisson model
–	David Jackett and David Griffiths DMS, Sydney*	Squash: the hustler
–	Richard Jarrett DMS, Melbourne*	An introduction to survival analysis
–	Ian James Mathematics Department, University of Western Australia, Nedlands, W. A. 6009	Linear regression with censored survival times
–	Graeme King Applied Mathematics, University of Adelaide #	On the numerical solution of an integral equation whose region of integration is unknown
–	John Knight DMS, Canberra*	Numerical inversion of a Laplace transform from geophysics
–	Robin Lamacraft DMS, Adelaide*	Update your data management

	Name and Address	Title
–	Nadav Liron Applied Mathematics, Weizmann Institute, Technion, Israel	Low Reynolds number fluid mechanics–Stokeslets solutions
–	Richard Litchfield DMS, Perth*	Wallows for buffaloes
–	Vivienne Lord DMS, Melbourne*	Analysis of trend in categorical data
–	Richard Lowry DMS, Hobart*	A general approach to the analysis of repeated measures experiments
–	Kim Malafant DMS, Canberra*	Some remarks on mini-computers
–	Geoff McLachlan University of Queensland, St. Lucia, Qld. 4067	A review of allocation procedures
–	Jenny McRostie DMS, Adelaide*	Educate your library files
–	Alan Miller DMS, Sydney*	Contours of confidence regions
–	Alan Miller DMS, Sydney*	A brief review of unconstrained optimization methods
–	Roger Payne DMS, Adelaide, and Rothamsted Experimental Station*	Avoiding pitfalls in ANOVA
–	Roger Payne DMS, Adelaide, and Rothamsted Experimental Station*	Allocation using discrete data
–	Doug Ratcliff DMS, Brisbane*	Choosing multivariate procedures
–	Doug Ratcliff DMS, Brisbane*	Design of a varietal trial with several planting dates
–	Dennis Reid DMS, Sydney*	Sex in athletics: vive la difference or expire la difference?
–	Ron Sandland DMS, Sydney*	Betting on Rugby League–mathematics or magic?
–	Christine Schafer DMS, Sydney*	Available subroutines for DMS
–	Doug Shaw DMS, Sydney*	Randomisation for sequential trials
–	Doug Shaw DMS, Sydney*	Nelder and Mead's simplex method
–	John van der Touw DMS, Melbourne*	Handicapping in golf
–	Dennis Sinclair DMS, Townsville*	Horse racing systems–how to beat the bookie without studying form
–	Lindsay Veitch DMS, Adelaide*	Stirling men's A2 squash autumn pennant 1979. Were we unlucky?
–	Graham Wilkinson University of Adelaide #	Systematic arrangements in field experiments

*For all DMS offices, address mail as follows: Division of Mathematics and Statistics, CSIRO, Banks Street, Yarralumla, ACT, P.O. Box 1965, Canberra City, ACT 2601.

#For University of Adelaide, address mail as follows: North Terrace, Adelaide, S. A. (Box 498 D, G.P.O., Adelaide, 5001).

APPLICATION OF LASERS TO CHEMICAL REACTIONS

Rudolph J. Marcus

The Institute for Molecular Science at Okazaki was described by Dr. Weissbluth in Vol. 4, No. 1, of this *Bulletin*. It is one of four national laboratories in Japan which are well-funded, particularly in terms of facilities and instrumentation.

The Institute hosts one or two scientific meetings each month. These last two days or more, and offer an opportunity for the Japanese research community to interact with foreign visitors resident at the Institute for varying periods of time.

During the summer, Professor C. Bradley Moore of the University of California Chemistry Department at Berkeley spent three months at Okazaki. A meeting on the application of lasers to chemical reactions was held 2-3 July 1979 in Professor Moore's honor and the following papers were given:

Name and Address	Title
– C. B. Moore Chemistry Department, University of California, Berkeley, CA 94720	Chemical reactions of vibrationally excited molecules
– S. Tsuchiya College of General Education, University of Tokyo, 3-8-1, Komaba, Meguro-ku, Tokyo 153	IR emission studies of energy partitioning in unimolecular reactions
– S. Kato Institute for Molecular Science, 38, Nishigo-Naka, Myodaiji-cho, Okazaki, Aichi 444	Theoretical characterization of transition state and energy partitioning in unimolecular dissociation reactions
– M. Katayama College of General Education, University of Tokyo, 3-8-1, Komaba, Meguro-ku, Tokyo 153	CW-CO_2-laser-induced collective excitation and isomerization of 1, 2-dichloroethylene
– H. Hanazaki Institute for Molecular Science, 38, Nishigo-Naka, Myodaiji-cho, Okazaki, Aichi 444	Multiphoton dissociation of ammonia
– K. Sakurai College of General Education, University of Tokyo, 3-8-1, Komaba, Meguro-ku, Tokyo 153	Time-resolved spectroscopy of BaO fluorescence (vibrational, rotational, and electronic energy transfer)
– M. Tasumi Department of Biochemistry, Faculty of Science, University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo 113	Infrared-induced rotation isomerization of 2-chloroethanol in low-temperature matrices
– I. Tanaka Department of Chemistry, Faculty of Science, Tokyo Institute of Technology, 2-12-1, Ohokayama, Meguro-ku, Tokyo 152	Sequential multi-photon absorption using a tunable dye laser

Name and Address	Title
– H. Kato Department of Chemistry, Faculty of Science, Kobe University, 1-34, Rokkodai-cho, Nada-ku, Kobe, Hyogo 657	Laser-induced fluorescence, energy transfer, and dissociation of Cs_2
– K. Kaya Department of Chemistry, Faculty of Science, Tohoku University, Aoba, Aramaki, Sendai, Miyagi 980	Multiphoton ionization spectra of benzene and its derivatives
– M. Kawasaki Department of Chemistry, Faculty of Engineering, Mie University, 1515, Kamihama-cho, Tsu, Mie 514	Photodissociation of molecular beams of aryl halides at 193 nm
– C. B. Moore Chemistry Department, University of California, Berkeley, CA 94720	Laser-induced photochemical reaction of formaldehyde
– K. Shibuya Department of Chemistry, Faculty of Science, Tokyo Institute of Technology, 2-12-1, Ohokayama Meguro-ku, Tokyo 152	Roles of vibrational and rotational energies in the non-radiative decay of formaldehyde
– T. Kobayashi The Institute of Physical and Chemical Research, 2-1, Hirosawa, Wako, Saitama 351	Primary process of visual pigments by picosecond spectroscopy
– N. Nakashima Institute for Molecular Science, 38, Nishigo-naka, Myodaiji-cho, Okazaki, Aichi 444	Picosecond studies on the local environments of coenzyme FAD

INTERNATIONAL SYMPOSIUM
CEREBRAL BLOOD FLOW AND METABOLISM

Rudolph J. Marcus

The 9th international symposium on cerebral blood flow and metabolism was held 28 May-1 June 1979 in Tokyo, Japan. Although no one from ONR/Tokyo was at this meeting, the abstracts of papers given at this meeting are available at this office and specific ones can be sent to those who request them.

The sessions at this meeting were devoted to

- Activation
- Metabolism
- Neurogenic control
- Methodology
- Experimental ischemia
- Brain edema: head injury
- Stroke
- Vasospasm: anastomosis
- Epilepsy: headache: dementia
- Cerebrovascular responses: miscellaneous topics

There were 138 papers and 121 poster presentations at this meeting, far too many to list in this *Bulletin*. A special lecture, "The (^{14}C) deoxyglucose method: four years later", was given by L. Sokoloff, Laboratory of Cerebral Metabolism, National Institute of Mental Health, Bethesda, Maryland 20205, U.S.A.

THE 1979 INTERNATIONAL PHYSICAL DISTRIBUTION CONFERENCE

Rudolph J. Marcus

The 1979 International Physical Distribution Conference was held 4-7 June 1979 in Tokyo. Although no one from ONR/Tokyo was at this meeting, the preprints of papers given at this meeting are available at this office and specific ones can be sent to those who request them.

The sessions at this meeting were devoted to
- Logistics system
- Physical distribution management
- Transportation
- Material handling system.

A listing of speakers at this meeting, their addresses, and titles of their papers follows.

Name and Address	Title
– Benjamin S. Blanchard Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061 U.S.A.	Life cycle costing–an overview
– R. Jünemann Gesellschaft für Logistik, e.v., c/o Universität Dortmund, Aufbau-und Vertüfunfs Zentrum, GB IV, Postfach 500 500, 4600 Dortmund 50, West Germany	Stepwise automation of logistical processes
– Kango Yamakoshi Kao Soap Co., Ltd., 1-1, Nihonbashi Kayaba-cho, Chuo-ku, Tokyo 103, Japan	Progress in the Kao Soap logistics system
– Omar K. Helferich Cleveland Consulting Associates, 6920 South Cedar Street, Suite 7, Lansing, Michigan 48910, U.S.A.	Strategic and operations logistics planning with computer simulation
– Peter S. Douglas The Chase Manhattan Bank, N.A., Woolgate House, Coleman Street, London, E. C. 2, England	Assessing the impact of fully developed logistics management systems on world trade and finance
– H. Weber WLM Weber Logistic and Management AG, Wilhelmstrasse 6, CH 8005 Zurich, Switzerland	Integrated logistics method for enterprise reorganization of a company
– R. D. Anderson Indiana University, 1300 West Michigan Street, Indianapolis, Indiana 46202, U.S.A.	An empirical assessment of physical distribution objectives
– J. W. Fraser Chrysler Corporation, Service & Parts Division, 15415 Fordline, Southgate, Michigan 48195, U.S.A.	The effective application of management by objectives to physical distribution management

	Name and Address	Title
–	A. H. Klawans Crooks Terminal Warehouses, Inc., 9441 W. Fullerton Ave., Franklin Park, IL 60131, U.S.A.	Productivity–the last game in town
–	B. W. Hupp Drake Sheahan/Stewart Dougall, Inc., 5725 East River Road, Chicago, IL 60631, U.S.A.	Profit opportunities and strategies in physical distribution
–	H. Yazawa Chiba University of Commerce, 1-3-1 Kōnodai, Ichikawa, Chiba-ken 272, Japan	Physical distribution cost accounting in Japan
–	Rudiger Welvers American Hoechst Corporation, Rt. 202-206, North Somerville, N.J. 08876, U.S.A.	Accounting for distribution cost–a practical application in chemical industry
–	Sol Lidsky Pfizer Inc., 235 East 42nd Street, New York, N.Y. 10017, U.S.A.	Centralized management organization of physical distribution in multidivisional corporation
–	Max-Michael Bliesener Gesellschaft für Vergasung und Verflüssigung von Steinkohle mbH, Gleiwitzer Platz 3, 4250, Bottrop, Deutschland, West Germany	Aiming for optimum costs in logistical systems
–	S. K. Kachhal Department of Industrial & Systems Engineering, The University of Michigan, Dearborn, 4901 Evergreen Road, Dearborn, Michigan 48123, U.S.A.	Performance measures in physical distribution
–	Jun Suzuki Nagasakiya Co., Ltd., 3-7-14 Higashi-nihonbashi, Chuo-ku, Tokyo 103, Japan	Automated assortment control for various item and small quantity linked with order entry system and management information system
–	Paul H. Zinszer University of Oklahoma, 307 W. Brooks, Rm. 1, Norman, OK 73019, U.S.A.	Development of a model to predict customer stock-out response
–	W. Reinicke Reinicke Consult GmbH, Gutenbergstrasse 4, 7022 Leinfelden-E. 2, West Germany	Possibilities and limitation of the information as a modern system for organization and control of PD
–	Vernon C. Seguin Marketing Department, Drexel University, 32nd & Chestnut Street, Philadelphia, PA 19104, U.S.A.	Physical distribution management in Australia–factors influencing company organization structure
–	Chikashi Nakanish Waseda University, 1-647 Totsuka-cho, Shinjuku-ku, Tokyo 160, Japan	Review and evaluation on public distribution center
–	Jushiro Nagase c/o Nissan Takarakai, Kobikikan Bldg., 6-17-2 Ginza, Chuo-ku, Tokyo 104, Japan	A trial toward the consolidation of the physical distribution of automotive goods
–	Kazui Kato Sumida Unyu Co., Ltd., 2-34-10 Asakusa, Taito-ku, Tokyo 111, Japan	The aspects of shoes coordinated distribution
–	Youichi Yoshioka The Distribution Systems Research Institute, 7-22-17 Nishi-gotanda, Shinagawa-ku, Tokyo 141, Japan	Planning on vegetables and fruits distribution systems, Part 1
–	Akio Amano c/o Ishidate Laboratory, Waseda University, 3-4-1 Ohkubo, Shinjuku-ku, Tokyo 160, Japan	Planning on vegetables and fruits distribution systems, Part 2–social influence resulting from modification of V.&F. transportation system

	Name and Address	Title
–	Masaharu Takeda Musashi Institute of Technology, 628-6 Seyamachi, Seya-ku, Yokohama 246, Japan	The physical distribution map for delivery in major cities and marketing strategies
–	K. J. G. Smith Transport Operations Research Group, The University of Newcastle upon Tyne, England	Costs and constraints in the delivery of goods to urban retail premises
–	Allan D. Schuster Graduate School of Business, Dept. of Management, The University of Texas at Austin, Austin, Texas 78712, U.S.A.	An evaluation of alternative pickup and delivery service strategies
–	J. M. Williams Director, National Materials Handling Centre, Cranfield Institute of Technology, Bedford MK43 OAL, U.K.	Aspects of city centre delivery in the UK
–	David Lowe David Lowe & Associates, Consultants in Transport and Distribution, Church House, Solihull Road, Hampton in Arden, Solihull, West Midlands B92 OEX, U.K.	The problems of overcapacity in delivery vehicle fleets
–	Kazuo Uasa Nittu Research Center, Inc., 12-9, 3-chome, Soto-kanda, Chiyoda-ku, Tokyo 101, Japan	The present conditions of P. D. subsidiary companies and their problems
–	Shigenobu Nomura Daido Industrial University, 2-21 Daido-cho-Minami-ku, Nagoya 457, Japan	A study on selection of transportation routes
–	Chikashi Nakanishi Waseda University, Totsuka-cho, Shinjuku-ku, Tokyo 160, Japan	Situation and problems on international logistics in Japan
–	Hiroshi Nomura Nittsu Research Center Inc., 12-9, 3-chome, Soto-kanda, Chiyoda-ku, Tokyo 101, Japan	Present and future of cargo transports between Honshu and Shikoku Islands
–	Paul Hesser Robert Bosch GmbH, 7000 Stuttgart 30, Postfach 300 240, West Germany	Experience with a new distribution center for automotive parts and spare parts
–	Hiromichi Ootaka K. K. Kurita Seizosho, Egawa, Gokamura, Sashima-gun, Ibaraki-ken 306-03, Japan	The logistics creation of the physical distribution revolution
–	S. K. Kachhal Department of Industrial & Systems Engineering, University of Michigan-Dearborn, 4901 Evergreen Road, Dearborn, Michigan 48128, U.S.A.	Selecting a level of mechanization for a physical distribution facility–a case study
–	Kazuho Yoshimoto c/o Nakai Laboratory, 2-22-2 Kamiochiai, Shinjuku-ku, Tokyo 161, Japan	A study on intraplant movement of materials
–	Tadataka Shiomi Murata Machinery Ltd., 2 Nakajima, Hashizume, Inuyama-shi, Aichi-ken 484, Japan	Automatic parts supply system for high-variety, low-volume production plant
–	Fred Schneider Digitron Ltd., Erlenstrasse 32, 2555 Brügg, Switzerland	Improved working conditions and productivity

Name and Address	Title
– Tsutomu Abe Kanda Transport Inc., 1-3-5 Ariake, Koto-ku, Tokyo 135, Japan	An effective distribution center by using voice-encoder and laser-scanner
– Rolf Jansen Gesellschaft für Logistik, e.v., c/o Universität Dortmund, Postfach 500 500, 4600 Dortmund 50, West Germany	Hospital logistics—limits in rationalization by use of automated goods transporting systems
– Kenneth B. Ackerman Distribution Centers, Inc., 1310 Dublin Road, Columbus, OH 43220, U.S.A.	The rise and fall of wooden pallets
– Tsunemi Mochinaga Kawatetsu-Interlake, Ltd., 2-17 Shiohama, Ichikawa, Chiba-ken 270-01, Japan	Case history—cold storage automated warehouse for frozen food
– Norbert Axmann N. Axmann-Fördertechnik, Am Ring 65, 6920 Shinsheim-Hoffenheim, West Germany	Operating expenses for an automatic pallet conveyor system
– Shoji Honda Daihatsu Motor Co., Ltd., 1-1 Daihatsu-cho, Ikeda-shi, Osaka 563, Japan	The promotion of physical distribution and the role of electric turret truck in central wholesale market
– J. E. Brown Material Management Systems, Inc., P.O. Box 332, Norwich, Vermont 05055, U.S.A.	The "push" system for inventory management
– Yutaka Karasawa IBM Japan Ltd., 3-2-12, Roppongi, Minato-ku, Tokyo 106, Japan	An optimal design for automated warehouse

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